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Bleaching, Singeing and Finishing of Cotton Cloth

Sizing and Its Materials—Oil Stains—The Singeing Operation—The Qualities of Good Bleaching—The Lime Bleach Process—The Caustic Boil—Chemicals of Bleaching—Types of Kiers and Their Operation—Recovery of Caustic—Starching and Back-Filling—Calendering and Its Apparatus

By D. B. ALEXANDER

IN the weaving of cotton cloth it is usually necessary to use yarns for the warp which have been sized so that they will stand the strains of weaving and not break in the loom. The filling yarns are not sized, inasmuch as they are not subjected to the same wear as the warp yarns, which have to stand the passing and repassing of the shuttle a number of times.

The sizings used vary in composition, and among the materials from which sizings are made may be found various starches, modified starches, gums such as gum ghatto, dextrines, beeswax or other waxes, tallow, mineral oil and paraffine, fillers such as talc or china clay, deliquescent substances such as calcium, magnesium or zinc chlorides, glycerine and a number of other products. At the present time the use of paraffine, calcium, magnesium and zinc chlorides is being discouraged, for the paraffine is hard to remove in the bleaching and the chlorides may cause a tendering of the cloth in the singeing operation due to the formation of hydrochloric acid. The chlorides may also injure the brass rollers on the singeing machines. A very good size can be made from materials which may be easily removed in the bleaching process. Such a size can be made by the use of starch, gum, and a mineral oil softener composed of red oil (oleic acid), mineral oil and a sulphonated oil. A softener of this type may contain 65 per cent mineral oil and still have the mineral oil in such an emulsified condition that it will readily wash out from the cloth even in cold water.

The woven cloth is known as gray cloth when it arrives at the bleach house for bleaching. Gray cloth contains the size added during the weaving process, the natural constituents of the raw cotton itself, such as oil, pectous materials, mineral and coloring matters, cotton wax, and, in addition, any oil and dirt stains picked up during the weaving, the weavers trying to prevent as many such stains as possible.

Improved types of lubricating oils have been found useful in reducing oil stains to a minimum. So-called "stainless oils," which are mixtures of mineral oils and saponifiable oils such as castor or lard, and the "non-fluid oils" which are mineral oils thickened with varying percertages of metallic soaps to give them the power to "stay put" are quite often found in use at the present time. In the case of stainless oils the animal oil combines with the alkali in bleaching to form a soap which at the same time emulsifies the mineral oil and removes it from the cloth in the subsequent washings. Non-fluid oil stains are harder to remove from the cloth, the idea in their use being not to get them on in the first place.

Mineral oil stains from any source are hard to remove from cloth. Before bleaching cloth containing mineral oil stains it is a practice to daub the stains with red oil (oleic acid). During the bleaching the red oil combines with the alkali to form a soap, and at the same time emulsifies the mineral oil and thereby removes it from the cloth. Red oiled cloth must not be boiled with lime as in that case lime red oil soaps are formed which are insoluble, sticky and very hard to remove.

The Singeing Operation and Its Object

Some cloths are singed before bleaching. This is accomplished by passing the cloth at a speed of from 180 to 220 yards a minute through a series of gas flames or overheated copper plates. The open gas flame type of singer is called the open singer and the cloth can be guided over the burners in such a way as to give a certain number of burners on the face of the cloth and a certain number on the back, or the burners may be all on one side of the cloth. The heated copper plate type of singer is called a plate singer and the cloth usually passes over two or three open gas flames, then over three stationary crowned copper plates heated to a red heat. A new type of plate

singer now coming into use consists of a single rotating copper roller over which the cloth passes. The temperature on this type of singer is automatically controlled and usually held at 1400 deg. Fahr.

The object of singeing is to burn off the fuzz on the cloth, clean out the intersections between the threads and help give the cloth a better appearance and luster. The open singer is used on openly constructed cloths, especially on voiles, while the plate singer is used on heavier cloths, and where you want a good luster on the finished goods, as on sateens.

Singeing is an important operation and must be carefully carried out. Faults in the finished goods blamed upon the dyer or finisher may have been the result of poor work on the part of the singer. The flames must be adjusted to the proper height and all guide rolls close to the flames kept clean and free from threads.

After singeing, the cloth is steamed or wet out with water in order to extinguish all sparks and prevent fires. Instead of wetting out with water, special cloths are sometimes wet out with malt extract, such as diastafor or with soap solutions. As a rule, after singeing the cloth drops into large wooden or cement pits from which the bleacher pulls it for bleaching. Sometimes it passes directly from singeing machines to the kiers and thus does away with one handling of the cloth.

The Qualities of Good Bleaching

The bleaching of cotton cloth is a term which has come to be used to really include three operations: the preliminary boiling out of the cloth with lime, caustic soda, soda ash or soap solutions; the souring of the cloth with acid, and the bleaching of the cloth with bleaching solution.

In the past the bleacher always tried to have his cloth well bottomed and a permanent white. By well bottomed was meant that the cloth had been well boiled out, soured and washed, and by permanent white, that the cloth would not yellow on storage. In the case of cloth that was to be used in printing, a permanent white also meant that the cloth must not yellow on being steamed, an operation through which printed cloths must go in order to set the colors. The unprinted parts of the cloth must come out white, although a faint yellowing may be corrected.

It has now been realized that it is not necessary to have a well-bottomed cloth or a permanent white for all work, and cloths are being processed in various ways, depending upon what the cloth must look like when finished and the uses for which it is intended.

Until recently the majority of the work went through one of the two processes, the lime bleach or the caustic bleach. The lime bleach eventually will probably be replaced by the caustic boil. Both processes are still in use when a first-class bleach is desired.

The Lime Bleach Process

Following is an outline of the two processes which will give a well-bleached cloth.

The lime boil:

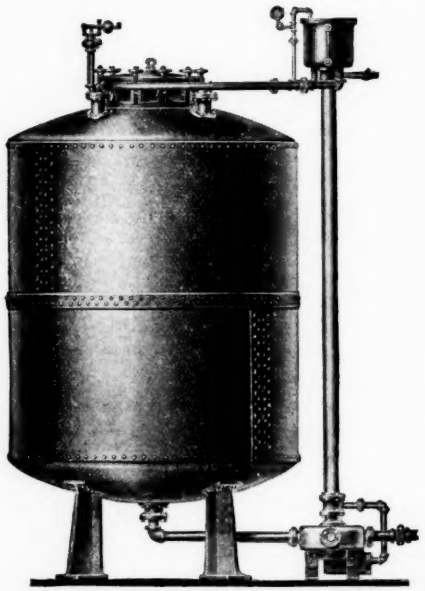
A. The wet cloth from singe room pits is run through a solution of lime water and into a large kier. The kier is then filled to a certain mark with water and the boiling started. The time of boiling and the pressure will vary.

B. The cloth is pulled from the kier, washed with water, passed through a dilute solution of sulphuric acid (hydrochloric may be used) and piled in a pit where it is allowed to stand for some time for the acid to react with the lime. The soured cloth is sprinkled with water at intervals to prevent the drying of the cloth with a resulting concentration of the acid to such a strength that it will weaken or tender the goods.

C. The cloth is washed with water and put into a kier for the second boil. The kier is filled with a solution of caustic soda (soda ash may be used and under certain conditions is cheaper) and the cloth given a second boil. Here again the time and pressure will vary.

D. The cloth is taken from the second boil, washed with water and passed through a bleaching solution, usually sodium hypochlorite known as soda chemic. A solution of calcium hypochlorite or lime chemic may be used. The cloth then goes to pits and is allowed to stand until the desired white is obtained. The cloth must not be allowed to dry during the bleaching or tendering of the cloth may result. This difficulty is overcome by lightly wetting the cloth with water at intervals.

E. The cloth is pulled from the chemic pits and washed, after which it passes through a weak solution of sulphuric



(Courtesy Textile Finishing Machinery Co.)

Bleaching Kier

acid (hydrochloric may be used) or one of sulphurous acid. This acid treatment is for the purpose of removing any excess chemic. The cloth is now thoroughly washed to remove the acid and the bleach is finished when the cloth has been dried on a set of drying cans.

Notes on lime bleach:

A. Insoluble lime soaps are formed in the first boil. These are decomposed by the sulphuric acid and form in the cloth an insoluble precipitate of calcium sulphate which is washed out. At the same time the fatty acids of the lime soap are liberated and being insoluble in water remain in the cloth. During the second boil the fatty acids react with the alkali and give soluble soda soaps which are washed out.

B. Souring the cloth also takes out the mineral matters occurring naturally in cotton and assists in the removal of iron stains.

C. The bleaching solution decomposes the natural coloring matters in cotton.

D. Sulphurous acid is now much preferred to sulphuric acid as a final sour, its main purpose being to act as an antichlor or chemic remover. In case all the sulphurous acid was not removed in the final wash of the cloth it would pass off as sulphur dioxide gas on the hot dry cans and not damage the cloth. On the other hand, any sulphuric acid not washed out would become concentrated on the dry cans and cause a tendering or weakening of the cloth. This trouble is frequently encountered when the latter acid is used.

The Caustic Boil

The caustic boil:

A. The wet cloth from the singe room pits is run through a solution of caustic soda and put into a kier. The kier is then filled with water and additional caustic solution and the cloth boiled.

B. The cloth is washed in water, soured in weak sulphuric acid and allowed to stand in pits, the time varying with different cloths.

C. The cloth is washed with water and put into a kier and given a second caustic soda boil. (Soda ash may be used) The cloth is now ready to enter the bleaching solution and from this point on is handled exactly as in the lime bleach.

Notes on caustic boil:

A. The caustic combines with the fats in the cloth to form soluble soda soaps which are washed out. The cotton wax is not saponified but is emulsified and removed from the cloth.

B. As in the case of the lime boil souring removes iron stains and decomposes traces of soap into fatty acids, which are resaponified in the second boil and washed from the cloth.

C. The chemic solution and subsequent souring are for the same purpose as in the lime boil.

D. The speed with which cloth is handled will vary from 100 to 275 yards a minute.

During the boiling of the cloth the kier liquor is continuously circulating through the cloth. The liquor is taken from the bottom of the kier and sprayed over the top of the cloth.

Types of Kiers and Their Operation

At the present time two types of kiers are in use, the steam injector and the circulating pump. The steam injector kier is the old type and the circulation of the liquor depends upon the condensation of steam injected into the pipe line leading from the bottom to the top of the kier. The kier is heated by the injected steam and one of the objections to this type of kier is that the hotter

(Courtesy Textile Finishing Machinery Co.)

Gas Singeing Machine

the kier gets the poorer becomes the circulation. This is because the injected steam approached the same temperature as the kier liquor and begins to stop condensing, thereby stopping the circulation. To overcome this trouble the incoming steam would have to be maintained at a much higher temperature, which would be expensive. In the circulation pump kier the liquor is withdrawn from the bottom of the kier by a pump and pumped to the top of the kier through a series of heating oils placed outside the kier. A much better circulation of the liquor is thus maintained. At the present time this kier is rapidly becoming the popular type.

Much experimental work is now being done on the bleaching of cotton cloth. The present tendency is to get away from two-boil work as much as possible, and give the cloth a single boil in caustic soda solution, wash, sour, chemic, sour, wash and dry. Such work is satisfactory for many purposes and results in a saving in labor, steam, time, amount of equipment required and under certain conditions in a saving in the cost of chemicals needed. It is probably but a question of time when all two-boil work will be done away with.

Chemicals of the Bleaching Process

A number of new types of solvent soaps are now on the market and there is considerable work to be done

on the uses to which they can be put in the textile industry, especially in boiling out and scouring work. Many of them possess very good wetting out properties.

The use of sodium peroxide in bleach house work would be increased if its cost could be reduced.

Enzymes are used to a considerable extent for the removal of starch from cloth previous to its being boiled out or scoured. Work is now being done to see if an enzyme can be developed or found that has the power to devour cotton wax without injuring the cellulose. Such an enzyme might cause many changes to be made in the bleaching of cotton cloth.

One hundred pounds of liquid chlorine and 350 pounds of soda ash will produce a good bleaching liquor for cotton cloth. Such a mixture when used at the property reduction strength will give a very good bleach in a few hours' time, keeps well for about one week, and does not produce an excessive odor of chlorine in the bleach house.

Flannel cloths used to be given a single kier boil using soda ash instead of caustic soda, but it has been found possible to improve on the work by passing the cloth through a hot, dilute solution of caustic soda and soap. The finished goods have a better feel and the threads are less contracted than is the case when kier boiled.

The Mercerizing of Cotton Cloth

In mercerizing cotton cloth the wet or dry cloth is passed through a strong solution of caustic soda, the excess caustic squeezed out and the cloth carried over a tentering machine which stretches it out to the width desired. Half way down the tenter the cloth is sprayed with water, and at the end of the frame passes through wash boxes and finally through a sulphuric acid solution to neutralize all the alkali. The cloth is then given a good washing and dried on dry cans.

As a rule, only the better grades of cotton cloth are mercerized. Mercerizing gives the threads a clean appearance, results in the cloth having a greater affinity for most dyestuffs and gives it a good luster. The strong caustic used produces a great shrinkage in the cloth, and upon being pulled out to its original width on the tenter frame the threads become rounded and smooth so that they reflect light better than the threads in unmercerized cloth and thus produce a silky luster.

The proper temperature of the mercerizing caustic is also often disputed. Some claim that the best luster results at a temperature of 40 deg. Fahr., others that the temperature does not make any difference provided it is not too high. Good mercerization can be obtained, using a caustic of 60 deg. Tw. at a temperature of 75 deg. Fahr. and giving the caustic thirty seconds to act upon the cloth before applying the sprays. The speed of mercerizing is usually fifty yards a minute, although some advocate speeds up to one hundred yards.

Recovering the Caustic

A recovery system should be run in conjunction with the mercerizing work whereby the caustic washed out of the cloth is caught in storage tanks from which it can be pumped for use in boiling out the cloth in the kiers, for scouring purposes, and for part of the charge in making up new mercerizing caustic. In the more recent types of recovery systems 97 per cent of the caustic padded on the cloth in mercerizing can be washed out and recovered.

By maintaining the proper ratio between the amount of cloth mercerized and the amount bleached, enough caustic can be recovered from the mercerizers to give all that is needed for the boiling in the kiers. Under such conditions the cost of caustic is at a minimum.

In the finishing of cotton cloth the cloth usually goes through at least one or all of three separate operations, namely, pure starching or back-filling, tentering and calendering. These operations as a rule take place in the order named.

Starching and Back-Filling Processes

In pure starching the cloth usually passes through a warm starch mixture and is given an even squeeze between two rolls, usually a brass roller with a wooden one on top, or a brass and rubber combination. The combination of the box containing the starch and the rolls is known as a starch mangle. From the mangle the cloth passes over a set of dry cans and then directly to the tenter machine which pulls the cloth out to the desired width and can square up the filling with the selvage of the cloth in case it is desired to do so. If the cloth has been pulled out of shape too much it may not be possible to do this.

In the back-filling of the cloth a mixture of starch and filler plus any other ingredients desired is applied to the back of the cloth in a back filling machine. The cloth passes over a large wooden drum partly submerged in the starch mixture, and as it comes out of the starch a doctor blade wipes off the excess of starch. The face of the cloth is held against the wooden roller so that the starch does not get onto the face of the cloth unless the mixture is too thin or is forced through to the face by too much pressure. As a rule the starch is not wanted on the face. After back-filling the cloth is dried on dry cans with its face to the cans and is then ready for the next operation.

The following is a list of some of the materials used in starching and in back-filling work: wheat, potato, corn, tapioca starches, corn, tapioca and potato dextrines or mixed dextrines of various starches, gum arabic, gum tragasol, gum shatto, rosin size, a size consisting of a mixture of beeswax, stearic acid and paraffine wax, sulphonated oils, so-called cream softeners which contain sulphonated fats or oils such as tallow, palm or castor oils, soluble waxes made with sulphonated oils, china clay, talc and various mineral fillers and a number of other products.

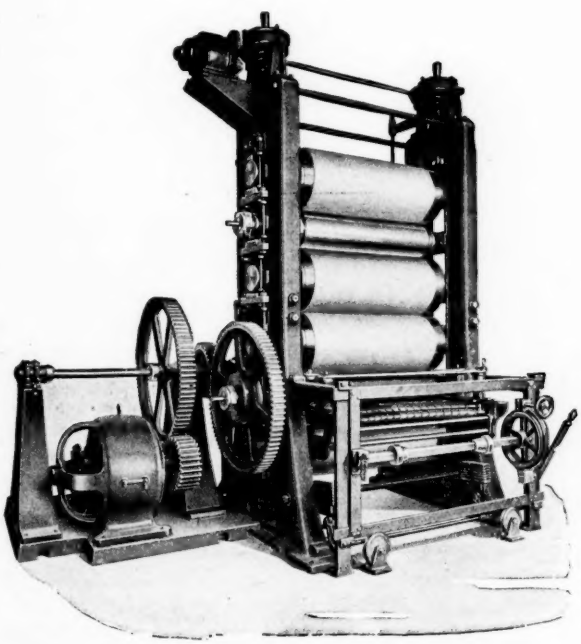
Sulphonated fats and oils are excellent emulsifiers and are used to a great extent in the manufacture of cotton

softeners from tallow, palm and castor oils and other fats. The oils and melted fats are treated with concentrated sulphuric acid for several hours at a low temperature. If the temperature gets too high, charring and decomposition takes place. The sulphuric acids combine with the fat, reacting with an OH group and making itself a part of the fat molecule. A sulphonated product containing 0.6 per cent sodium oxide may form an emulsion with water without a fat separation, whereas if no sulphonation had been made, a much higher alkalinity would be required to get an emulsion without fat separation, and then it would not be as good for some purposes as the one with less sodium. The one with the least sodium would contain the more free fat or oil. It would be more oily, while the one with the higher per cent of sodium would be more soapy.

Calendering and Its Apparatus

The last operation in the finishing of cotton cloth is calendering. This is really an ironing operation and has to do with the smoothing out of the cloth, the putting on of a glazed or shiny finish or the production of a silk-like appearance. The final appearance of the cloth depends upon the use of the proper starch mixture along with a suitable calender.

As an illustration, a very good finish can be produced on a broadcloth by first giving the slightly dampened cloth a run through the charmeuse calender at a high temperature, then passing the cloth through a starch mangle containing a beeswax, stearic acid and paraffine emulsion, drying on cans, tentering and then given a run on a chasing calender putting twelve strands of cloth through the same nip.



(Courtesy B. F. Perkins & Sons, Inc.)

Six-Roll Rolling Calender

Sateens can be given a silky appearance by first giving them a charmeuse calendering, then a softening with an oil softener, and finally a schreiner calendering.

The following types of calenders are in use:

Five bowl plain calender
Three bowl plain calender
Friction calender
Charmeuse calender
Schreiner calender
Chasing calender

The 5 and 3 bowl calenders consist of alternating steel and husk, paper or composition rollers, superimposed one upon another. The steel rollers are smaller in diameter and can produce a small amount of friction on the cloth. Some of the steel rollers can also be warmed if desired, and then give a slight glaze to the cloth. These calenders are known as plain calenders and primarily are for the ironing out of the cloth, and in the case of cloths too stiffly sized will help break down the size and give a softer feel.

In the friction calender a small steel roll rotates over a slower moving husk, paper or composition roller of much larger size and imparts to the cloth a glaze.

The charmeuse calender works the same as the friction calender and is constructed along similar lines only is much heavier in build. Heavy pressure can be applied to the cloth and the steel roll is run at a high temperature. This calender is used on cloths where more permanent luster is wanted, and in such a case the cloth is usually given a charmeuse first, then softened and tentered and then given a schreiner calendering.

A schreiner calender is a heavily constructed two-roll calender. The top roll is an engraved steel roller having a number of finely engraved lines on the surface which run parallel to one another and at an angle to the axis. A popular type of roll is engraved at an angle of 45 deg. and has 450 lines to the inch. The engraved roller is run hot and under heavy pressure. These fine lines result in the cloth having a very good luster when finished.

The chasing calender is a five-bowl calender and the cloth passes over a series of guide rollers in such a way that a number of strands of cloth go through one nip at the same time. This causes the threads to ride on one another and make them rounded so that a linen-like finish is obtained.

NEW DYE STANDARDS LIST

A supplementary list of dye standards has been made public by the Treasury Department. It contains the names of seventeen dyes added to the standards, sixty-three others for similitude to dyes previously listed, and removes four from previous listings.

Process of Producing Ice Colors on Cotton

Recently Patented by Karl Jellinek and Wilhelm Christ, of Offenbach-on-the-Main, Germany, Assignors to I. G. Farbenindustrie Aktiengesellschaft, of Frankfurt-on-the-Main, Germany

WHEN developing ice colors with non-acid—that is, neutral—or with soda alkaline diazo solutions, there is the danger of a progressive decomposition of the diazo compound produced by the alkaline solution which, together with the padded material, is put into the dye bath, making it alkaline with caustic alkali, so that unsatisfactory feeble or troubled or non-uniform dyeings are liable to be obtained. This inconvenience comes especially to light in dyeing in a standing bath and in the case of tetrazo compounds, so that it was hitherto difficult to obtain according to this method with diazo solutions uniform lots certain to be satisfactory.

Now it is found that the injurious action of the caustic alkali upon the diazo compound can be overcome by adding to the diazo bath substances that will neutralize the alkali of the padding solution without acidifying the bath; such as, for example, an alkaline bicarbonate or a suitable metal salt (such as magnesium sulphate or zinc chloride), or both together.

According to this method, the diazo baths remain free of products of decomposition, giving uniform and clear dyeings.

The following examples illustrate the invention:

EXAMPLE 1

The cotton goods are padded with a solution containing 10 gr. of the para-chloroanilide of 2.3-oxynaphthoic acid, 15 c.c. of Turkey Red oil, 15 c.c. of caustic soda solution of 34 deg. Be. and 10 c.c. of formaldehyde of 30 per cent standard in the liter, well wrung out and developed in a diazo solution of meta-xylidin. The diazo solution is prepared as follows: 2.5 gr. of meta-xylidin are mixed with 5 c.c. of hydrochloric acid of 20 deg. Be. and dissolved in 25 c.c. of hot water. After cooling down, the solution is poured while stirring into a solution, cooled with ice, of 1.5 gr. of sodium nitrite of 98 per cent standard. The diazotation is finished in ten minutes. Then soda is added until the solution begins to show an alkaline reaction, and then 5 gr. of sodium bicarbonate are added.

In this manner bluish-red shades are obtained. The dyeing bath remains completely clear.

EXAMPLE 2

The cotton goods are padded with a solution containing 12 gr. of the anilide of 2.3-oxynaphthoic acid, 15 c.c. of Turkey Red oil, 18 c.c. of caustic soda solution of 34 deg. Be. and 12 c.c. of formaldehyde, well wrung out and developed with a diazo solution of 4.4'-diaminodiphenylamine. This diazo solution is prepared as follows: 4 gr. of 4.4'-diamidodiphenylamine are dissolved in 20 c.c. of hot water. After cooling down, 50 c.c. of cold water and 20 gr. of ice and 10 c.c. of hydrochloric acid of 20 deg. Be. are added. Then, slowly, while stirring continuously, a solution of 3 gr. of sodium nitrite in 5 c.c. of water is poured in. After ten minutes the diazo solution is neutralized with chalk and 5 gr. of magnesium sulphate are added.

Dark black shades are obtained. The dye bath is neutral after the development.

EXAMPLE 3

The cotton goods are padded with a solution containing 3 gr. of the alpha-naphthalide of 2.3-oxynaphthoic acid, 6 c.c. of Turkey Red oil, 9 c.c. of caustic soda solution of 34 deg. Be. and 3 c.c. of formaldehyde of 30 per cent standard in the liter, and well desiccated. Then the cotton is developed in portions of 50 kg. in 1,000 liters of a diazo solution of dianisidine. For the first 50 kg. of padded cotton the following diazo solution may be prepared: 1.2 kg. of dianisidine are dissolved with 1.05 liters of hydrochloric acid of 20 deg. Be. in 25 liters of boiling water. After cooling down, 15 kg. of ice, 10 liters of water and 0.95 liter of hydrochloric acid of 20 deg. Be. are added. Into this solution slowly, while stirring continuously, 0.7 kg. of sodium nitrite of 98 per cent standard, dissolved in 1 liter of water, is poured. The diazo solution is neutralized with chalk, made up to 1,000 liters and 0.8 kg. of zinc chloride and 10 kg. of sodium bicarbonate are added.

For each following lot of 50 kg. of cotton goods an addition to the bath is to be made, prepared as follows: 0.45 kg. of dianisidine are diazotized in the above-described manner and neutralized. To this diazo solution 0.2 kg. of zinc chloride and 2 kg. of sodium bicarbonate are added.

SPECIAL ISSUE OF T. I. JOURNAL

The British Textile Institute has published a Special Issue of its Journal containing the papers on textile subjects read at the meeting of the British Association for the Advancement of Science, at Leeds, during the first week of September. The contents of this issue include an exhaustive illustrated treatise on the Standardization of the Fastness of Dyestuffs, by Dr. S. G. Barker; Moisture Relations of Colloidal Fibers, by Dr. J. J. Hedges; Some Chemical Aspects of Wool Research, by A. T. King; Ultra-Violet Radiation as an Aid to Textile Analysis, by H. R. Hirst; and a number of important papers on the study of sheep in relation to wool production and types of wool fibers, the growing of cotton, the action of sunlight on cotton; papers outlining studies on the properties of rayon, on textile testing, air conditioning, silk-fibroin, etc.

Proceedings of the American Association of Textile Chemists and Colorists

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REPORT OF THE SUB-COMMITTEE ON LIGHT FASTNESS

1. Light Exposures, Series 3.

I. INTRODUCTION

On December 5, 1925, we made a report of certain light* exposures, to be hereafter referred to as Series No. 3, in which twenty dyed samples were exposed to daylight in various ways, and to other forms of illumination as well, and certain conclusions were reached. Since that time additional exposures of the same series of dyeings have been made and further data gathered, and it now seems desirable to publish the results in considerably more detail. No attempt will be made, however, to correlate the results obtained with the variable factors of daylight exposures which were responsible for them. More detailed studies of the effect on fading of variations in the spectral distribution of the light, its intensity, the humidity of the air about the samples, and other environmental factors are in progress and will be reported in due time.

In choosing the dyes for Series No. 3, we endeavored to select a list which would be fairly representative, but at the same time, to make the test as severe as possible, we purposely included a number of dyes which we had previously found to be somewhat abnormal in their fading; that is, rather more sensitive than the average to variations in the conditions of exposure, such as the moisture content of the air and the quality of the light. The list follows:

1. One-half per cent Erio Chrome Cyanine RC (Geigy), top-chromed, on wool.
2. One-half per cent Erio Chrome Geranol R (Geigy), top-chromed, on wool.
3. Two per cent Erio Green Extra (Geigy), dyed acid, on wool.
4. Two per cent Indigotine CCC (Geigy), dyed acid, on wool.
5. One-half per cent Alizarine Yellow R (Grasselli), top-chromed, on wool.
6. Two per cent Erio Violet RL (Geigy), dyed acid, on wool.
7. Indigo, dyed in the vat a cadet shade, on cotton.
8. One and one-half per cent Benzo Fast Blue 4GL (Bayer), dyed direct, on cotton.
9. One and one-half per cent Direct Sky Blue 6B Conc. (Newport), dyed direct, on cotton.
10. One-half per cent Safranine T Extra (Du Pont), dyed on tannin mordant, on cotton.
11. One per cent Pontamine Fast Yellow 4GL (Du Pont), dyed direct, on cotton.
12. One and one-half per cent Indanthrene Gold Orange G Dbl. (Badische), vat dyed, on cotton.
13. Four per cent Ciba Blue 2BD (S. C. I.), vat dyed, on cotton.
14. Naphthanil Blue B Base (Du Pont), dyed a dark navy on Naphthol AS prepare, on cotton.

*In this report the term "light" is not used in the strict sense of "visible radiant energy," but is used indifferently to include ultra-violet and infra-red radiation as well.

15. Two per cent Erio Chrome Cyanine RC (Geigy), top-chromed, on silk.
16. Four per cent Direct Violet R (Calco), dyed with acetic acid, on silk.
17. Five per cent Indigotine Conc. (N. A.), dyed with sulphuric acid, on silk.
18. Five per cent Primuline J (Jennings), developed with beta-naphthol, on silk.
19. Two per cent Hematine (Campbell), on iron mordant, on silk.
20. Naphthanil Blue B Base (Du Pont), dyed a dark navy on Naphthol AS prepare, on silk.

The fabrics used for these dyeings were half-blood worsted cloth, plain weave, weighing 8 ounces to the yard, scoured; cotton cloth, plain weave, weighing 3 ounces to the yard, fully bleached; and "Cinderella" silk cloth, unweighted, plain weave, weighing 1½ ounces to the yard, completely degummed.

The dyeings were cut up into pieces measuring 3 by 2½ inches, and exposed to light in a variety of ways.

The conditions of exposure and the fading results, which are described at length in the body of the report, are summarized in the table on pages 712 and 713. Exposures were made in the following places:

Daylight Exposures.—Fourteen sets were exposed at the Bureau of Standards, Washington, D. C., by W. D. Appel; two sets at the Wabasso Cotton Company, Inc., Three Rivers, Que., by Lucius Collins; two sets at the U. S. Finishing Company, Cedartown, Ga., by Leslie L. Bamberger; one set at the Case Research Company, Auburn, N. Y., by D. B. Eldred; one set at the American Printing Company, Fall River, Mass., by A. E. Hirst; one set at Cheney Brothers, South Manchester, Conn., by W. M. Scott; one set at Calistoga, Calif., by W. H. Fieldhouse.

Violet Carbon Arc (Fadeometer) Exposures.—Two sets were exposed at the Bureau of Standards, Washington, D. C., by W. D. Appel; two sets at the Pacific Mills, Lawrence, Mass., by W. H. Cady; two sets at Cheney Brothers, South Manchester, Conn., by W. M. Scott.

Incandescent Lamp Exposures.—Nine sets were exposed at the Bureau of Standards, Washington, D. C., by W. D. Appel.

In every case at least one-half of the sample was covered with lightproof material during the exposure. During certain of the daylight exposures a photoelectric cell and automatic recorder were used to measure the amount and intensity of radiant energy.

The purpose of these tests was twofold. We wished to determine to what extent daylight fading is influenced by such factors as the presence or absence of a glass shield; the angle of exposure; free access of air to the exposed portion, or difficult access; the quality and quantity of the light, as, for example, direct sunlight, north sky, or cloudy sky light, and whether the exposure is continuous day and night in all weathers or only when the sun is shining; also the effect of variations in humidity, of different seasons of the year, and different geographical locations. We wished further to ascertain whether there is an artificial source of illumination sufficiently like the sun in the quality of its fading to enable it to be used safely as a sun substitute. This, in turn, involved the selection of one particular daylight exposure as a standard for comparison with the artificial lights.

II. Daylight Exposures

Turning first to the daylight tests: the fourteen sets exposed at Washington, on the roof of the Chemistry Building of the Bureau of Standards,[1] were intended to show the effect of the following variable factors:

1. *The Influence of Glass.*—Two sets were exposed side by side, facing south, at an angle of 45 degrees from the horizontal, between 9 a. m. and 3 p. m. on sunny days only, under identical conditions except that one set was covered by ordinary window glass, with free access of air to the dyeings, and the other set was uncovered. Seven of the dyeings faded equally in the two sets; three (Nos. 1, 7 and 9) faded slightly more, and nine (Nos. 2, 4, 5, 6, 8, 10, 13, 15 and 17) materially more without glass; and one (No. 20) faded more under glass.

2. *The Effect of the Angle of Exposure.*—Three sets were simultaneously exposed under identical conditions except that one set was horizontal; one was vertical facing south; and one at an angle of 45 degrees facing south. All were covered with glass, with no air space about the samples. Seven of the horizontal dyeings (Nos. 9, 10, 12, 13, 14, 17 and 20) faded slightly more than the corresponding dyeings at 45 degrees; the remaining thirteen faded equally in the two sets. All of the vertical dyeings faded appreciably less than those at 45 degrees.

3. *The Influence of Free Access of Air.*—Two sets were exposed side by side, under identical conditions except that in one set the samples were pressed between the glass cover and a black backing, and in the other there was an air space of 1 inch, open at both ends, between samples and cover. Nine of the dyeings faded the same in the two sets. Seven (Nos. 4, 7, 8, 17, 18, 19 and 20) faded perceptibly more with access of air, and four (Nos. 10, 12, 13 and 14) faded materially more without access of air.

4. *The Difference Between Sunny and Cloudy Sky.*—Two sets were exposed alternately one to sun and clear sky and the other to cloudy sky (according to the weather conditions) until they had faded about equally, on the

[1] Supplemented later by the sets exposed in six other localities.

average. Nine dyeings faded about equally in the two sets. Eight (Nos. 3, 4, 5, 11, 14, 16, 17 and 18) were faded more by the sun, and three (Nos. 1, 2 and 15) were faded more by the cloudy sky.

5. *The Difference Between North and South Light.*—Two sets were exposed continuously facing north and south respectively (both vertical), all other conditions being identical. Out of a total of 147 daylight hours of exposure, 102 were cloudy and 45 sunny. Nine of the dyeings faded equally in the two sets. Three (Nos. 4, 8 and 14) faded slightly more, and six (Nos. 3, 9, 16, 17, 18 and 20) materially more in the south exposure, and two (Nos. 7 and 10) slightly more in the north exposure.

6. *The Difference Between a Continuous Exposure, Day and Night, and in All Weathers, and an Exposure to Sun and Clear Sky Only.*—Two identical sets were exposed at an angle of 45 degrees, facing south, one continuously, the other only between 9 a. m. and 3 p. m. standard time, on days when the sun was shining. Both sets were under glass, with access of air. Six samples faded equally in the two sets. Nine (Nos. 4, 5, 8, 10, 12, 13, 14, 17 and 20) faded perceptibly more, and five (Nos. 1, 2, 7, 9 and 15) decidedly more in the continuous test. It should be added that the continuous test was exposed nine days (in October), and the "sun only" test forty hours, requiring twenty days for its completion owing to bad weather.

7. *The Effect of the Time of Year.*—Identical sets were exposed in Washington (on sunny days only) in spring, summer, autumn and winter, the exposures being all timed to produce about the same average total fading. The winter test was conducted on two successive winters, 1925-26 and 1926-27; the former required 111 hours and the latter only 61.5 hours. All the samples faded equally in these two sets except two (Nos. 5 and 11), both yellow, which faded a trifle more in the earlier exposure. Comparing the four seasons, we find the following: By comparison with the summer exposures, the autumn exposures were equally faded in nine cases and perceptibly less in eleven (Nos. 3, 4, 6, 7, 8, 9, 10, 12, 17, 19 and 20); the winter exposures were equally faded in fifteen cases, less faded in two (Nos. 9 and 12), much less in one (No. 7) and more faded in two (Nos. 5 and 18); the spring exposures were equally faded in thirteen cases, less faded in four (Nos. 7, 9, 10 and 12) and more faded in three (Nos. 5, 6 and 18). Identical sets were also exposed (under similar conditions) in Three Rivers, Que., in summer and winter. Twelve samples faded equally in the two sets; five (Nos. 3, 4, 6, 17 and 19) faded more, and three (Nos. 1, 2 and 9) less, in the summer exposure. Identical sets were also exposed in Cedartown, Ga., in summer and winter. Fourteen samples faded equally in the two sets; six (Nos. 3, 4, 6, 7, 11 and 17) faded more in the summer. There was a close resemblance in the fading of these two pairs of exposures (Three Rivers and Cedartown), but less resemblance between them and the corresponding pair of exposures made in Washington, though the differences were confined almost entirely to the wool dyeings. All of the seasonal tests were made under glass, with access of air, and exposed from 9 a. m. to 3 p. m., on sunny days only. The duration of these tests was as follows:

Washington, Summer	46.7 hours
Washington, Autumn	40.0 hours
Washington, Winter	111.0 hours
Washington, Winter	61.5 hours
Washington, Spring	52.0 hours
Three Rivers, Summer	40.0 hours
Three Rivers, Winter	71.0 hours
Cedartown, Summer	75.0 hours
Cedartown, Winter	80.0 hours

8. *The Effect of Geographical Location.*—(A) Exposures under glass. Six sets were exposed, all in the summer time, under practically identical conditions (the same as in the seasonal tests) in six different places: Washington, D. C.; South Manchester, Conn.; Fall River, Mass.; Cedartown, Ga.; Three Rivers, Que., and Calistoga, Calif. (fifty-eight miles north of San Francisco). On comparing the other five exposures with that made at Washington, we find the following: Of the South Manchester samples, seventeen were equal and three (Nos. 10, 18 and 20) faded more. Of the Fall River samples, eight were equal, eleven (Nos. 3, 5, 6, 8, 9, 10, 11, 13, 17, 18 and 20) faded slightly more, and one (No. 4) much more. This set was slightly overexposed. Of the Cedartown samples, all were faded more, twelve of them much more. This set was considerably overexposed. Of the Three Rivers samples, eighteen were equal, one (No. 6) faded slightly more, and one (No. 7) slightly less. Of the Calistoga samples, nine were equal, seven (Nos. 5, 6, 10, 11, 15, 17 and 19) faded slightly more, and four (Nos. 3, 4, 18 and 20) much more. This set was slightly overexposed. A comparison of the Calistoga and Fall River exposures is of particular interest. By good luck the two sets were faded on the average to almost exactly the same degree, and we find the fading equal in seventeen samples, two (Nos. 8 and 13) faded slightly more in Fall River, and one (No. 18) slightly more in Calistoga. The interesting point here is that the Calistoga exposures required sixty sun hours to equal forty-eight sun hours at Fall River, no doubt because of the higher humidity at the latter place.

(B) Exposures without glass. Duplicate sets were exposed at Washington, D. C., and Auburn, N. Y., in the summer on sunny days only, without any glass cover. Fifteen of the samples faded equally in the

two exposures; four (Nos. 3, 4, 11 and 20) faded more at Auburn, and one (No. 10) less. The differences were all small. The Auburn exposure required 44.7 hours, and the Washington 46.7 hours.

Comments on the Sun Tests

It will be noticed that almost no mention has been made of the effect of atmospheric humidity on fading in any of the above tests. Although a careful study of these exposures will reveal many instances where humidity has appreciably affected the results (as in the Calistoga-Fall River comparison) it was decided that humidity effects can best be observed in conjunction with the incandescent lamp exposures, where they can be more rigidly controlled. With regard to the other variable factors: one would infer from an examination of the twenty dyeings in this series, exposed to sun with and without glass, that fading under glass is likely to be considerably different from fading in the open. However, our experience with Series IV[2], in which over 1,200 dyed samples were exposed to the sun simultaneously, both with and without glass, does not confirm this finding, and indicates on the contrary that the influence of glass has been much overrated. It is our belief that the effect of a glass shield is often needlessly magnified by a lack of care in keeping it clean. Regarding the angle of exposure, this appears to influence the total fading materially, but not the relative fading. Free access of air to the samples exposed under glass has a marked effect (compared with difficult access), and must be taken into account. The "sun and cloudy sky" and "north and south light" tests show that the quality of the light has an important bearing on the relative fading, and there is a material difference between "sun-fading" pure and simple, and fading produced by a continuous exposure in all kinds of weather. Here also humidity no doubt plays an important part. On the other hand, the exposures made under identical conditions to sunlight only at different seasons of the year in the same place, and in different places at the same time, show comparatively few differences. From all of the above, we feel justified in urging the importance of a general agreement on some *one* method of making daylight tests, and its universal adoption in the textile industry. We believe that on the whole, the method which we have referred to as our standard sun test (exposures between 9 a. m. and 3 p. m. on sunny days only, at an angle of 45 degrees facing due south, under glass with free access of air) is the best all-around method. It has one distinct advantage over a continuous exposure, in that during at least six months from March to September, the fading from 9 a. m. to 3 p. m. on sunny days varies but little from day to day, and this in our opinion more than compensates for the somewhat longer time required and more labor involved, as compared with a continuous exposure. We believe that by the use of our standard sun test a greater degree of uniformity in relative fading can be obtained than by any other daylight exposure method. In conjunction with this test some sort of fastness standards will doubtless be found useful to determine the end of the exposure period; we are looking into the question of suitable standards, and hope soon to have something to recommend.

III. Violet Carbon Arc Exposures

Six sets of dyed samples were exposed, each for forty hours, in the fading lamp commonly known as the "Fadeometer," consisting of a violet carbon arc enclosed in a glass globe, surrounded by a metal cylinder which supports the samples to be exposed, all at the same distance from the arc, namely 10 inches. Of the six sets, two were exposed at the Bureau of Standards, Washington, D. C.; two at the Pacific Mills, Lawrence, Mass., and two at Cheney Bros., South Manchester, Conn. The data for current, temperature, etc., were as follows:

	Amperes	Volts	Deg. Fahr.
Washington, first	13-16	225-230	
Washington, second ..	11-12	217-222	138
Lawrence, first	14	215	150
Lawrence, second	14	215	145
S. Manchester, first....	14-16	203	140-150
S. Manchester, second.	14-16	203	140-150

Comparing the results of each pair of exposures in the same lamp, we find substantial uniformity. Fifteen of the twenty samples faded the same in the two exposures to the Washington lamp, fifteen in the Lawrence lamp, and seventeen in the South Manchester lamp. The remainder showed only slight differences. Comparing the results in the three lamps, we find somewhat more variation. The Washington lamp had the most fading action and the Lawrence lamp the least. Compared with the Washington exposures, only one of the Lawrence exposures showed equal fading, four showed slight differences, and fifteen quite material differences. Eleven of the South Manchester exposures showed fading equal to Washington, eight were faded slightly less, and one materially less. Com-

[2] A preliminary report of Series IV was made at the annual meeting at Charlotte last December and published in the American Dyestuff Reporter, **15,** 857 (December 27, 1926). (Out of print.)

paring the three Fadeometers with the standard sun test (south exposure at an angle of 45 degrees, under glass, with free access of air, from 9 a. m. to 3 p. m. on sunny days only) we obtain the following data:

Washington: Seven samples faded to the same extent as in the sun, one (No. 18) slightly more, ten (Nos. 3, 4, 5, 6, 11, 13, 15, 16, 17 and 19) materially more, one (No. 7) slightly less, one (No. 9) materially less.

Lawrence: Ten samples faded to the same extent as in the sun, two (Nos. 6 and 11) materially more, four (Nos. 1, 10, 18 and 20) slightly less, four (Nos. 7, 8, 9 and 14) materially less.

South Manchester: Six samples faded to the same extent as in the sun, four (Nos. 5, 13, 16 and 17) slightly more, five (Nos. 3, 4, 6, 11 and 19) materially more, four (Nos. 1, 7, 10 and 14) slightly less, one (No. 9) materially less.

Comments on the Violet Carbon Arc

This lamp is in general use in the textile industry, and is no doubt the most convenient and satisfactory light source at present available for making quick fading tests. Whether it can be considered a reliable substitute for the sun for purposes of standardization seems doubtful, in view of the differences in the relative fading by lamp and sun already described. However, it should be stated that in our Series IV light tests, which includes over 1,200 dyed samples, there is less difference, on the average, between the lamp and sun fadings than is shown in Series III, owing to the fact that in Series III, as already mentioned, the dyes used were purposely selected with the object of making the test as severe as possible, while in Series IV the purpose was merely to test a large number of dyes, regardless of their individual behavior. If someone will devise a lamp having the same high rate of fading as the violet carbon arc, but with a spectrum more like that of the sun, and preferably with humidity control, it should go a long way towards solving the problem of light testing.

IV. Incandescent Lamp Exposures

Nine sets of dyed samples were exposed to incandescent lamp light under controlled conditions of atmospheric humidity, intensity, and temperature at the Bureau of Standards with the apparatus devised by Appel[3]. In the majority of the experiments a 1,000-watt gas-filled mazda lamp was used and the excessive infra-red radiation was absorbed by a 1 per cent solution of copper sulphate contained in a heavy glass bell-jar about the lamp. The radiation from the lamp had to pass through about one inch of the copper sulphate solution and through the bell-jar to reach the samples. The lamp was operated on a constant voltage line and by actual test had a color temperature of 2962 deg. K. The samples were located about 5 inches from the center of the lamp bulb and were rotated about it during the exposure to compensate for irregularities in the arrangement of the filaments, variations in the thickness of the copper sulphate solution, or flaws in the bell-jar. A tabulation of the exposure conditions is given at the bottom of page 714.

A comparison of the incandescent lamp exposures with the standard sun exposures follows:

Samples Fading More in the Lamp Than in the Sun

Set	Sample
1....	
2....	88, 90.
3....	84, 88, *90*.
4....	80, 84.
5....	80, 84.
6....	71, 72, 77, 79, *80*, 82, 83, *84*, 85, 90.
7....	84, 90.
8....	*84*.
9....	*84*.

Samples Fading Less in the Lamp Than in the Sun

Set	Sample
1....	71, 72, 73, *74*, 75, 76, 77, 78, 79, 80, 81, 82, 83, *85*, *86*, *87*, 88, *89*, 90.
2....	71, 72, 73, *74*, 76, 77, 81, 85, 86, 87, 89.
3....	71, 74, 76, 77, 89.
4....	72, 73, *74*, 76, 77, 78, 81, 85, 86, *87*, 89.
5....	73, *74*, 76, 77, 78, 81, 85, 86, *87*, *89*.
6....	73, *74*, 76, 81, 86, *87*, 89.
7....	71, 72, 73, *74*, 75, 76, 77, 78, 81, 85, 86, *87*, 89.
8....	*74*, 76, 77, 78, 81, *87*, *89*.
9....	73, *74*, 76, 77, 78, 81, *87*, *89*.

[Note: An italic number indicates a material difference; a number not in italic indicates only a slight difference.]

Comments on the Incandescent Lamp

In studying these comparisons the fact should be borne in mind that a number of the dyes were chosen because they were known to behave "abnormally" in light exposure tests. Set 1 is comparable with the standard sun exposure, since the time of the two exposures was the same and the humidity was low in both cases. It is evident from the results that the lamp is not nearly powerful enough in its fading action compared hour for hour with sunlight between 9 a. m. and 3. p. m. on clear days. Doubling the time of exposure (Set 2) makes the re-

[3] American Dyestuff Reporter, **14**, 882 (December 28, 1925).

SET NO.	SAMPLE NUMBER																				SET NO.
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
42																					42
43	+	+	=	+	+	++	+	++	+	+	=	=	+	=	+	=	+	=	=	-	43
44	=	=	=	-	=	=	-	-	=	++	=	+	++	++	=	=	-	-	-	=	44
45	-	-	--	--	-	-	--	-	--	=	-	-	-	=	—	—	--	—	--	--	45
46	=	=	=	=	=	=	-	-	+	++	-	++	++	++	=	=	=	=	=	=	46
63	+	=	--	--	-	-	-	-	-	-	--	-	=	-	=	-	--	--	--	--	63
81	++	++	-	--	=	=	++	-	--	++	-	=	=	=	=	--	--	--	-	=	81
82	++	++	=	-	=	=	+	=	-	+	-	=	=	+	=	-	=	-	-	+	82
65	++	++	-	=	=	=	+	=	=	=	+	=	+	=	+	=	=	=	-	=	65
66	=	=	-	-	=	-	-	-	-	-	=	-	=	=	=	=	-	=	-	-	66
52	=	=	=	=	=	=	=	=	=	+	=	=	=	=	=	=	=	+	=	+	52
62	=	=	+	++	+	+	=	+	+	+	+	=	+	=	=	=	+	+	=	+	62
72	=	=	=	=	=	+	-	=	=	=	=	=	=	=	=	=	=	=	=	=	72
79	=	=	++	++	+	+	=	=	=	+	+	=	=	=	+	=	+	++	+	++	79
70	=	=	=	=	+	=	--	=	-	=	=	-	=	=	=	=	=	+	=	=	70
76	=	=	=	=	+	+	-	=	-	-	-	-	=	=	=	=	=	+	=	=	76
51	-	=	++	++	+	++	-	=	--	-	++	=	+	-	=	+	+	=	++	=	51
48	+	+	-	--	=	-.	+	=	+	++	-	+	+	++	+	-	++	=	-	+	48
64A	=	-	-	--	=	-	-	-	=	+	-	=	=	+	-	-	--	=	++	=	64A
49A	-	-	-	--	=	-	--	=	=	=	-	=	=	=	-	-	-	+	-	+	49A
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	

SAMPLE FADED (=) EQUAL TO, (+) SLIGHTLY MORE THAN, (++) MUCH MORE THAN, (-) SLIGHTLY LESS THAN,

(--) MUCH LESS THAN THE CORRESPONDING SAMPLE IN SET 42.

SET NO.	CONDITIONS OF EXPOSURE							
42	SUNLIGHT	9 TO 3	GLASS	45° SOUTH	AIR	46.7 HOURS	SUMMER	WASHINGTON, D.C.
43	"	"	NO GLASS	"	"	"	"	"
44	"	"	GLASS	"	NO AIR	"	"	"
45	"	"	"	V[a]. SOUTH	"	"	"	"
46	"	"	"	HORIZONTAL	"	"	"	"
63	CLOUDY	"	"	45° SOUTH	AIR	49.6 HOURS	AUTUMN	"
81	DAYLIGHT	CONTINUOUS	"	V[a]. NORTH	"	11 DAYS[b]	SUMMER	"
82	"	"	"	V. SOUTH	"	"	SUMMER	"
65	"	"	"	45° SOUTH	"	9 DAYS	AUTUMN	"
66	SUNLIGHT	9 TO 3	"	"	"	40.0 HOURS	"	"
52	"	"	"	"	"	38 HOURS	SUMMER	S. MANCHESTER, CONN.
62	"	"	"	"	"	48 HOURS	"	FALL RIVER, MASS.
72	"	"	"	"	"	40 HOURS	"	THREE RIVERS, QUE.
79	"	"	"	"	"	60 HOURS	"	CALISTOGA, CALIF.
70	"	"	"	"	"	61.5 HOURS[c]	WINTER	WASHINGTON, D.C.
76	"	"	"	"	"	52 HOURS	SPRING	"
51	FADE-OMETER (CHENEY BROS., S. MANCHESTER, CONN.)					40 HOURS		
48	MAZDA C	1000 WATTS	93.6% HUMIDITY			46.7 HOURS		
64A	"	" "	65% HUMIDITY			47.5 HOURS		
49A	"	" "	34% HUMIDITY			94 HOURS		

a V = VERTICAL

b 147 DAYLIGHT HOURS: 102 CLOUDY, 45 SUNNY

c A DUPLICATE SET EXPOSED THE PREVIOUS WINTER REQUIRED 111 HOURS.

sults more nearly comparable; but although seven samples are now faded to the same extent as the corresponding sun exposures and two are overexposed, eleven samples are still underexposed. Increasing the time of exposure to three times that of the sun tests (Set 3) gives an average agreement, though three samples are overexposed, one of them markedly, and five are underexposed, one of them markedly. Twelve of the twenty samples are shown to require 147 lamp hours to equal 47 sun hours. By increasing the humidity of the air about the samples to 65 per cent (Set 4), better results are obtained than in Set 1, since only eleven of the twenty samples are too little faded in an exposure of the same duration as the sun exposure. Increasing the humidity to 80 per cent (Set 5) throws an additional sample out of the "too little" class. Increasing the humidity to 93.6 per cent (Set 6) decreases the number of samples that are too little faded to seven. Of the remainder, ten are too much faded, two of them markedly so, and three are a match for the sun test of the same duration. Thus is shown the important relation between atmospheric humidity and fading, high humidity very markedly accelerating the fading of some dyeings. In this connection a direct comparison of Set 1 (low humidity) with Set 6 (high humidity) shows no sample to be less faded in Set 6 than in Set 1 and sixteen to be more faded in Set 6. It should be noted, however, that some of the dyeings are not affected to the same extent by humidity, and therefore high humidity cannot be used to speed up the fading produced by the lamp to make it hour for hour like sun fading for all dyeings. Set 7 received somewhat too short an exposure, but is near enough to Set 5 to show that the copper sulphate has had little effect in reducing the effective fading light.

Increasing the lamp size to 1,500 watts and the exposure to fifty-three hours, Sets 8 and 9, and using a humidity of 75 to 80 per cent, gives considerably better agreement between lamp and sun. There are still about 40 per cent of the samples which do not fade enough. In order to make the lamp work satisfactorily, a very much higher intensity would be necessary.

In these and earlier experiments with the incandescent lamp as a source the quality of the fading was observed to be very much like one or another of the daylight exposures. In our judgment the lamp is somewhat superior to the carbon arc in this respect.

By using a very much larger lamp or battery of lamps such that the intensity in the blue, violet and ultra-violet down to, say, 440 mμ approximates that in sunlight at the earth's surface, it may be possible to obtain satisfactory results with this light source. The practical difficulty of removing the large excess of infra-red radiation and the cost of the large size lamp and of current required do not encourage further work on the utilization of the incandescent lamp for routine tests. However, the method of fading is very satisfactory for studies of the fading process under strictly controlled conditions and new equipment of a different design using one or more larger lamps has been built at the Bureau of Standards for this purpose. Tests now under way include studies of intensity, humidity and temperature effects. The fading is being followed with quantitative color measurements.

V. Experiments with the Photoelectric Cell

A complete report of experiments with the barium photoelectric cell prepared at the Bureau of Standards is published immediately following this report, and the details need not be repeated here. It is only too apparent that the quantity of radiant energy falling on a sample as measured by the cell is not a measure of the fading produced. It is safe to say that no other device for measuring light will have any better success than the Case Photoelectric Cell, so long as it does not take into account such factors as humidity, quality of the light and other variables.

VI. Summary

Twenty-nine identical sets of twenty selected dyeings have been exposed to daylight under a variety of conditions, and in different localities at different

Tabulation of Exposure Conditions

	Time in Hours	Relative Humidity	Temp.	Other Conditions
Set No. 1.....	47.0	35.0%	40° C.	This and all other exposures except 6 and 9 were continuous.
Set No. 2.....	94.0	34.0%	40° C.	
Set No. 3.....	147.0	38.0%	40° C.	
Set No. 4.....	47.5	65.0%	39° C.	
Set No. 5.....	47.5	80.0%	35° C.	
Set No. 6.....	46.7	93.6%	40° C.	Intermittent exposure, exposed during the day only.
Set No. 7.....	45.0	88.0%	40° C.	Distilled water used about the lamp instead of copper sulphate.
Set No. 8.....	53.0	75 to 80	39° C.	1,500-watt lamp used.
Set No. 9.....	53.0	75 to 80	39° C.	1,500-watt lamp used, intermittent exposure.

times of the year, repeatedly to violet carbon arc light, and under controlled conditions of atmospheric humidity to incandescent lamp light. The exposures were timed so as to obtain the same average fading in each set. Records of the energy received by some of the samples were obtained with the aid of a barium photoelectric cell and automatic recorder. Although general conclusions are hardly justified by the relatively few samples studied, the evidence clearly points to the following:

1. The relative fading in a series of dyeings exposed to daylight is decidedly influenced by the type of exposure, whether to direct sunlight, north sky, or cloudy sky light, and whether the exposure is continuous day and night in all weathers or only when the sun is shining.

2. Approximately reproducible relative fading in a series of dyeings exposed to daylight is obtained at widely separated stations in the United States when the following conditions of exposure are observed. Samples are exposed at an angle of 45 degrees from the horizontal facing south, between 9.00 a. m. and 3.00 p. m. on sunny days only, in a cabinet covered with a good grade of window glass approximately one-eighth of an inch thick and open at the sides in such a way as to allow free access of air to the samples. The distance between the samples and the glass should be not less than one-half inch.

3. The test described under *2* is recommended at this time as standard for a daylight exposure test.

4. No artificial light source can be recommended at this time as standard for light exposure tests. The violet carbon arc is convenient, and no doubt the best available for quick tests. The incandescent lamp is not practicable.

5. The quantity of radiant energy falling on dyeings during exposure, as recorded by a photoelectric cell, does not correspond to the amount of fading produced.

6. The fading of dyeings by light is materially influenced by the conditions of exposure such as the humidity of the air about the samples, and the amount of the influence varies among the individual dyeings. A control of atmospheric conditions about the samples is essential for a standard laboratory test.

It should be understood that Series 3 light exposures were in a way preliminary, and that Series 4, to which reference has been made several times, will present similar data covering a very large number of samples. Series 4 includes five sunlight tests and one with the violet carbon arc with over 1,200 dyed samples in each test. The large majority of these exposures have been completed, but the compilation of a report on them is a large undertaking which probably will not be finished until the summer of 1928.

VII. Acknowledgment

Our thanks are due to the following gentlemen outside of our committee who co-operated with us in making some of the exposures: Lucius Collins, Leslie L. Bamberger, W. H. Fieldhouse and D. B. Eldred.

For the Committee:

William H. Cady,
William D. Appel.

Report on Experiments with the Photoelectric Cell in Relation to Testing Fastness to Light of Dyed Materials[1]

By W. D. Appel[2]

Bancroft [3] suggested that dye fading tests could be put on a quantitative basis by measuring the amount of effective "light" [4] falling on the samples in daylight exposure tests, the idea being that the same quantity of energy would produce the same amount of fading regardless of daily or seasonal fluctuations in the intensity of the light, or of atmospheric variation. The Case photoelectric cell [5] was suggested for this purpose. The Research Committee of the American Association of Textile Chemists and Colorists and the Bureau of Standards were interested in the proposal, and the following work was made possible by the co-operation of the Case Laboratory, the Association and the Bureau. The Case Laboratory lent the equipment for the tests and ran one test; the Association supplied the dyed materials; the Bureau of Standards carried out the experimental work.

The Photoelectric Cell

The barium high-vacuum glass photoelectric cell [6] and a Leeds and Northrup type 8551 recording potentiometer were used to make a continuous record of the irradiation. According to the manufacturer, the photoelectric cell is

[1] Publication approved by the Director of the Bureau of Standards, Department of Commerce, Washington, D. C.

[2] Associate chemist, Bureau of Standards.

[3] American Dyestuff Reporter, December 31, 1923, page 936.

[4] In this report the term "light" is not used in the strict sense of "visible radiant energy," but is used indifferently to include ultra-violet and infra-red radiation as well—i. e., energy irrespective of wave lengths.

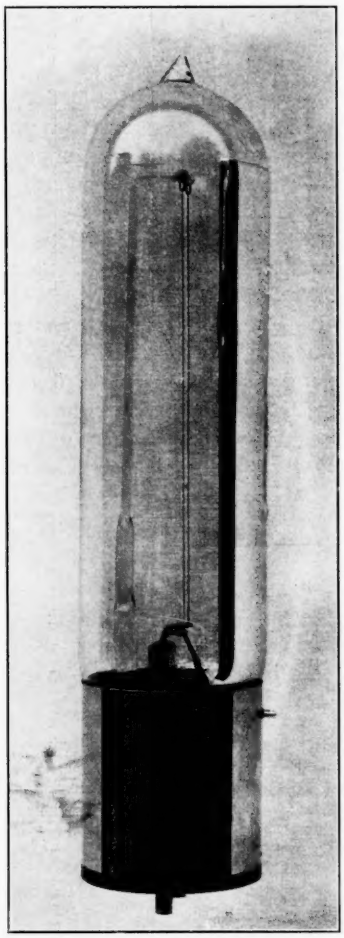
[5] Manufactured by the Case Research Laboratory, Auburn, N. Y. See descriptive literature put out by the laboratory. Also T. W. Case, New Strontium and Barium Photoelectric Cells, Phys. Rev. **17**, 398 (1921).

[6] Described in Bulletin No. 6, March, 1923, of the Case Research Laboratory.

sensitive to near ultra-violet and to visible radiation, but insensitive to the infra-red. It is most sensitive to blue and violet radiation. Thus it covers the spectral regions present in daylight that are considered active in dye fading. The height of the curve drawn by the recorder above the axis of abscissas at any time is said to be directly proportional to the radiant energy received by the cell at that time, and the area between the curve and axis of abscissas for any period is proportional to the quantity of energy received by the cell during the period.

Materials

The dyed samples used in these tests are listed below. They include different chemical types of dyes, three different fibers, and different methods of dyeing.



Barium High Vacuum Daylight Cell

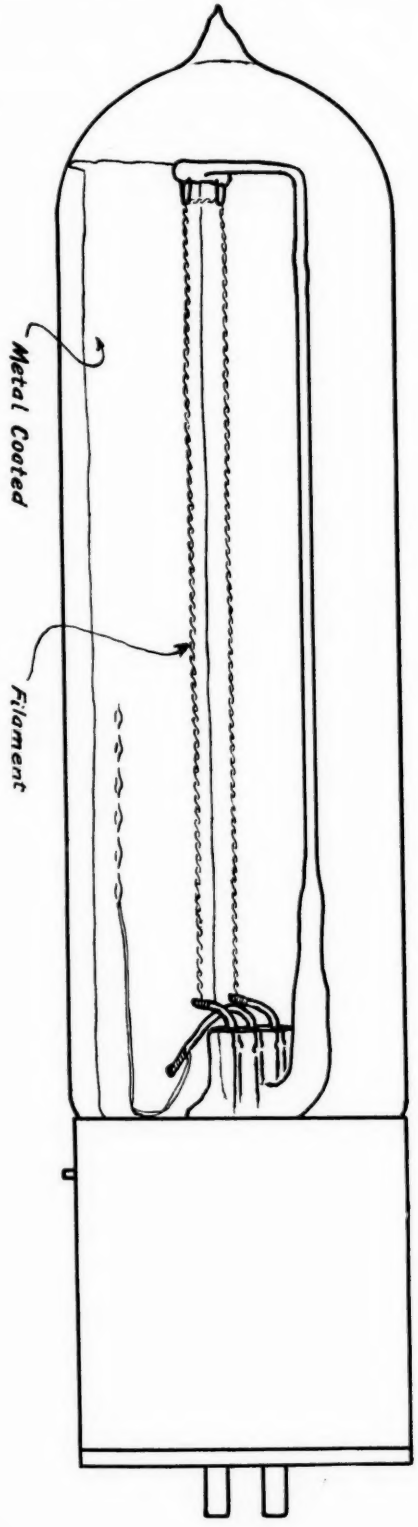
List of Dyed Samples

1. One-half per cent Erio Chrome Cyanine RC (Geigy), top-chromed, on wool.
2. One-half per cent Erio Chrome Geranol R (Geigy), top-chromed, on wool.
3. Two per cent Erio Green Extra (Geigy), acid, on wool.
4. Two per cent Indigotine CCC (Geigy), acid, on wool.
5. One-half per cent Alizarine Yellow R (Grasselli), top-chromed, on wool.
6. Two per cent Erio Violet RL (Geigy), acid, on wool.
7. Indigo (cadet shade) (Du Pont), vat, on cotton.
8. One and one-half per cent Benzo Fast Blue 4GL (Bayer), direct, on cotton.
9. One and one-half per cent Direct Sky Blue 6B Conc. (Newport), direct, on cotton.
10. One-half per cent Safranine T Extra (Du Pont), tannin, on cotton.
11. One per cent Pontamine Fast Yellow 4GL (Du Pont), direct, on cotton.
12. One and one-half per cent Indanthrene Golden Orange G Dbl. (Badische), vat, on cotton.
13. Four per cent Ciba Blue 2BD (S. C. I.), vat, on cotton.
14. Naphthanil Blue B Base on Naphthol AS, on cotton.
15. Two per cent Erio Chrome Cyanine RC (Geigy), top-chromed, on silk.
16. Four per cent Direct Violet R (Calco), dyed with acetic acid, on silk.
17. Five per cent Indigotine Conc. (National), dyed with sulphuric acid, on silk.
18. Five per cent Primuline J (Jennings), Diaz. B. Nap., on silk.
19. Two per cent Hemadol (Campbell), iron mordant, on silk.
20. Naphthanil Blue B Base on Naphthol AS, on silk.

Procedure

Each sample was 2½ by 3 inches in size, and approximately one-half of each sample was exposed to light, the other half being covered with thin sheet aluminum. The back of the sample was covered with heavy black cardboard except under the exposed portion, which was open to permit free access of air through it. When not out for exposure or examination, the samples were kept in the dark.

Except Set 56, all exposures were made on the roof of the Chemistry Building, United States Bureau of Standards. Set 56 was exposed at the Case Laboratory, Auburn, N. Y. Identical sets of the dyeings were exposed under the several conditions given below. They were examined from time to time, and when considered to be faded on the average to the same extent as Set 43 (Set 42



in some cases), which was taken as the standard, the exposure was terminated. The total hours of exposure and the areas under the curves given by the photoelectric cell exposed along with the samples were then computed. The area for an exposure was taken to be a measure of the amount of energy received during the exposure. By dividing this area by the hours of exposure, a figure representing the average intensity—that is, energy per hour of exposure—was obtained. The values for the different tests are given in the accompanying table (page 718).

Conditions of Exposure

Set 42.—Under glass, at an angle of 45 degrees to the horizontal facing south, 46.7 hours between 9 a. m. and 3 p. m., when the sun was shining, between June 4 and 22, 1925. The samples were exposed in a wooden cabinet with ordinary window glass cover. They were 1 inch from the glass and several inches from the back of the cabinet. The glass cover extended 4 inches beyond the samples. Openings in the ends of the cabinet permitted free access of air to the samples. The Case cell was not under the glass cover of the cabinet, but was in the open, at an angle of 45 degrees facing south.

Set 43.—Free, at an angle of 45 degrees to the horizontal facing south, 46.7 hours simultaneously with Set 42 and under identical conditions except that there was no cabinet and no glass cover, the samples being exposed in the open.

Set 47.—Under glass, vertical facing north, free access of air, eight days and nights continuously, July 7, 2 p. m., to July 15, 2 p. m. Like Set 42, except that the samples (and cabinet) were in the vertical position facing north. Although there were several days of sunshine and clear skies during this period, most of the days were partly cloudy and in the afternoon or evening on several days thunder-showers occurred. The period was one of rather high average relative humidity. The Case cell in this test faced north and was under glass from the same piece as that of the cabinet. The number of hours of light strong enough to be registered by the cell in this test was 112.

Set 56.—Like Set 43, but carried out at the Case Laboratory, Auburn, N. Y. The exposure was made between 9 a. m. and 3 p. m., when the sun was shining for 44.7 hours between July 11 and September 23. The Case cell used to measure the light was previously adjusted to register the same as the one used at the Bureau of Standards for the other tests.

Set 63.—Under glass, at an angle of 45 degrees to the horizontal facing south, free access of air, 49.6 hours between 9 a. m. and 3 p. m. when the sun was *not* shining between October 7 and October 27, 1925.

Set 65.—Similar to 63, but continuous exposure day and night, 2 p. m. October 7 to 10 a. m. October 16 (exclusive of a few hours when brought in for examination). The total number of hours of daylight strong enough to be registered by the Case cell was 100.9. Of this time 17.3 hours was sunlight exposure, 22.7 hours cloudy sky exposure and 6.9 hours perhaps one or the other, all between 9 a. m. and 3 p. m., and the remaining 54 hours was exposure to the low intensity light before 9 a. m. or after 3 p. m.

Set 66.—Similar to 63, but when the sun was shining, 40 hours between 9 a. m. and 3 p. m., between October 7 and October 27, 1925.

The Fading Produced

A comparison of the nature and amount of fading in the tests may be made as follows:

1. Sets 43 and 56 are in excellent agreement in their fading.

2. Set 42 is on the whole somewhat less faded than Set 43 (and 56), but one sample is more faded in Set 42 than in 43. Six samples are considerably more faded in Set 43, seven are slightly more faded in Set 43 and six are faded to about the same extent in the two sets. The samples comprising Set 42 must have received less light than Set 43 and the photoelectric cell, owing to losses by reflection from the glass cover, yet with the exception of six samples they have faded nearly as much as Set 43. The fact that some have faded more and some less indicates the presence of other factors than the amount of radiant energy which have an influence on the rate of fading of the individual dyeings.

3. Set 66 may be said to match Set 42, though Samples 9, 19 and 20 are somewhat less faded in Set 66 than in Set 42, and some other samples are very slightly less faded.

4. Set 63 has faded slightly less than Set 42, though Samples 2, 10 and 13 are faded to the same extent in the two sets and 1 has faded more in Set 63 than in Set 42. Admittedly underexposed, it is still remarkable that in practically the same time of exposure Set 63 exposed under glass to cloudy sky has faded nearly as much as Set 42 exposed under glass to direct sunshine. In Set 63 Samples 1 and 10 in particular have faded to a distinctly different hue than in the sun exposures. Other tests indicate that this effect may be attributed to higher humidity at the time of exposure.

5. Set 65 shows this humidity effect, if humidity is the only cause, in the case of Samples 1, 2, 15 and 17, all of which have faded to a decidedly different hue than in Sets 42, 43 and 66. The four samples referred to above and 7, 9 and 13 have faded more in Set 65 than in Set 42. Eleven samples have faded to the same extent in the two cases. Sample 19 has faded less in Set 65 than in Set 42, and Sample 11 has faded too little to judge.

6. Set 47 resembles Set 65 and is a good match for it in the quality of the fading. Set 47 is on the average slightly less faded than Set 65, though the difference is not great.

7. In general, pronounced differences in the fading of Sets 47 and 65, which are low intensity exposures, are evident in comparison with Sets 42, 43, 56 and 66, which are high intensity exposures. Set 63 is intermediate between the two extremes. These differences are not constant throughout the set, but are shown by certain of the

Relative Energy, as Measured by the Photoelectric Cell, Required Under Different Conditions to Produce Approximately Equal Fading

Set No.	Conditions of Exposure	Daylight Hours of Exposure	Total Energy[a]	Av. Energy per Hr. of Exposure
56	Sun and clear sky, no glass, 45 degrees facing south, 9 a. m. to 3 p. m. in July to September	44.7	13650	305
43	Sun and clear sky, no glass, 45 degrees facing south, 9 a. m. to 3 p. m. in June	46.7	11857	254
42	Sun and clear sky, under glass, 45 degrees facing south, 9 a. m. to 3 p. m. in June	46.7	11857[b]	254[b]
66	Sun and clear sky, under glass, 45 degrees facing south, 9 a. m. to 3 p. m. in October	39.6	7374[b]	186[b]
63[c]	Cloudy sky, under glass, 45 degrees facing south, 9 a. m. to. 3 p. m. in October	49.9	3903[b]	78[b]
65	Continuous, night and day, under glass, 45 degrees facing south in October	100.9	7528[b]	75[b]
47	Continuous, night and day, under glass, vertical facing north in July	112.0	2458	22

(a) Represented by the area between the curve and axis ofabscissas for the exposure.
(b) The photoelectric cell was not under glass, and thereforereceived more light than the samples.
(c) Set 63 is underexposed.

samples only, others behaving the same under the different conditions. In other words, the spectral distribution of the light, the humidity of the atmosphere about the samples, or other factors play so important a part in the fading of dyed materials that the relative fading of a sample in comparison with other samples under one set of normal daylight exposure conditions may be entirely different from the relative fading under another set of normal daylight exposure conditions.

Amount of Radiant Energy and Fading

The experiments described above may now be tabulated along with the average radiant energy per hour of exposure and the total quantity of energy received. (See table, page 718.)

Sets 56, 43 and 47 are comparable, the photoelectric cell having been exposed in the same way as the samples. Except for a few samples which are more faded than in Sets 56 and 43, Set 47 would be considered underexposed.

Sets 42, 66, 63 and 65 are comparable, the cell having been exposed direct, the samples under glass. Probably Set 66 is slightly underexposed, 63 is certainly underexposed and 65 may be slightly overexposed.

Allowing for the effect of the glass covering in the second group of sets, the two groups are comparable.

It is apparent that even when generous allowance is made for possible misjudgment of the amount of fading undergone by the samples, the quantity of energy received during exposure, represented by the area of the curve given by the photoelectric cell, does not correspond to the amount of fading. This may be attributed in part to the fact that environmental influences such as humidity, which do not affect the cell, have a marked effect on the rate of fading of dyeings. Thus for most of the materials high atmospheric humidity has been found to accelerate fading. In sunny-day exposures the air about the samples is, on the average, much drier than in cloudy-sky or continuous exposures. Another controlling factor is the difference between the cell and individual dyeings in sensitivity to radiation of different wave lengths. These and other variables are being studied experimentally and will be discussed at length in later papers.

It is interesting to note that, other factors being disregarded, the greater the irradiation (as measured by the cell) the less its efficiency in fading. Thus more incident energy is required to produce the fading when the average intensity is high than when the average intensity is low. Sets 56 and 47 are extremes in this respect, the first requiring 5.5 times as much energy as Set 47, which was exposed at an average intensity of one-fourteenth that of Set 56. Set 65, which is an apparent exception, received both high and low intensity radiation over considerable periods of time, and therefore the average area per hour for this set given in the table does not represent any one prevailing condition.

Conclusion

The conclusion drawn from these experiments is that the amount of fading of dyed textiles under variable conditions of daylight exposure is not adequately measured by the incident energy recorded by the barium photoelectric cell.

OCTOBER MEETING OF RHODE ISLAND SECTION

The October meeting of the Rhode Island Section of the American Association of Textile Chemists and Colorists was held in the rooms of the Providence Engineering Society on Friday evening, October 21, 1927, at 8 o'clock. John Hutton, Chairman, presided.

H. R. Davies, Vice-President and Treasurer of the Dyestuff Corporation of America, presented a paper entitled "A Proposed Method of Testing the New Wetting-Out Materials," published below. An interesting discussion followed at the conclusion of this paper.

The meeting adjourned at 9.30, preceding which a rising vote of thanks was rendered the speaker. Sixty members were present.

Albro N. Dana,
Secretary.

A Proposed Method of Testing the New Wetting-Out Materials

By H. R. Davies
Dyestuff Corporation of America

Within the last few years considerable interest has been shown in the production and use of materials designed purely for the wetting-out of fibers, and remarkable properties have been claimed for a great variety of substances which have been produced for this purpose, though not all of them live up to their advance notices.

It is easy to see, of course, that the thorough and complete wetting-out of material which has to be later dyed and bleached is essential. Practically all of the fibers used in the textile industry are contaminated in some way with material of one sort or another which hinders or opposes its immediate and thorough saturation with water. There is a natural grease, for instance, in the wool fiber, the wax and pectic matters contained in cotton, the sericin and

gum present in large quantities in raw silk and, in addition, when fabricated yarns or pieces are considered, the spinning oils and various sizings which are used in their manufacture.

Some of these materials, it will be apparent, lie more or less on the surface of the fiber or yarn, and others permeate right through the individual fiber.

In order, therefore, to have clean and workable stock, it is essential that the detergent material used be one which will penetrate to the ultimate heart of the individual fibers if good, level, perfectly penetrated dyeings are to be produced.

Real Value of Solvents Often Exaggerated

The materials used, from the earliest times, for the accomplishment of this object, are soaps and alkalies, varied in their nature, but of similar chemical and physical characteristics.

More than twenty years ago the use of so-called "solvents" as additions to the ordinary materials used for scouring and wetting-out were proposed, and combinations of soaps, sulphonated oils and various volatile organic solvents have, during the past generation, found an extended use as scouring and penetrating agents.

Such materials as benzole, gasoline, carbon tetrachloride, and later the chlorinated hydro-carbons, such as dichlor-ethylene and tetrachlor-ethane, have been combined with various fatty acids, sulphonated oils and soaps, sold under trade-marked and copyrighted names, and the wildest claims made for the wonderful results achieved by their use in the processes of wetting-out and scouring of textile materials.

There is no doubt that many of these materials do play an important part in scouring operations and have a certain efficacy in certain processes.

It seems, however, as Schofield rightly points out in his book, "The Wet Processes of the Wool Industry," that the use of the word "solvents" creates rather a wrong impression as to what actually takes place when such a combination as has been outlined above has been used for the purpose of wetting-out and penetrating textile materials. He says:

"The name 'solvents' as applied to these and analogous substances, is certainly misplaced in the detergent aspect. Every member of the general list above is, in greater or less degree, an active solvent for oils, fats, resins, gums and similar bodies, but the action in scouring cannot be a matter of direct solution only. In an ordinary woolen scour of four pieces there may be 30 pounds of wool oil to be removed from the cloth in the ratio, say, of 25 pounds olein to 5 pounds mineral oil. Additions of solvent to scours are usually of the order of ½ to 1 pint. Without pushing the discussion too far, it is surely impossible for a pound or so of solvent to exercise much direct dissolving action in a case of this kind."

It is very likely that there are two entirely distinct phases to be considered in determining the value of various materials which might be offered for the general purpose of wetting-out and scouring. The first action of completely wetting-out and penetrating the material depends almost wholly on the reduction of the surface tension of the scouring medium and of the interfacial tensions existing between the material to be scoured and the scouring liquid. After the goods are thoroughly impregnated, however, the removal of the foreign matter is principally a matter of emulsification, and this depends not only on the reactions between the scouring media and the cloth, but also on its reactions with the materials it is desired to remove. As emulsification is also very largely a question of reducing surface tensions it seems as though any material which well and efficiently wet-out will also be of material aid in the actual scouring and have actual value as a detergent. The test, therefore, of wetting-out efficiency has, to some extent, an added importance in considering the value of a material used in the capacity of a detergent.

New Types of Solvent

I have neither the intention nor the ability to enter into a long discussion as to the physical and chemical reactions underlying scouring processes. It is sufficient, I think, to realize that the lowering of the various interfacial tensions is the one essential which any good penetrating and scouring assistant must possess.

Two or three years ago an entirely new class of material was offered for the accomplishment of this purpose. A powder, known as "Nekal A Dry," was placed on the market with the claim that it had incomparable wetting-out and dissolving properties and excellent emulsifying capacity. Nekal A Dry was of an entirely different class from the so-called "solvent" class of wetting-out assistants, being the sodium salt of a propylated naphthalene sulphonic acid. This product in simple water solution most efficiently penetrates almost any material of a textile nature, and can also be used for the wetting-out of powders such as Indigo, Paranitraniline, etc., which resist wetting-out with ordinary water.

Since the introduction of "Nekal A Dry" there have been many similar products offered, a few of which are: Leonil, Flerhenol, Oranit, Neomerpin, Isomerpin (various brands), the last two of which are manufactured in this country by the Newport Chemical Works,

while Nekal A and a succeeding brand, "Nekal B X Dry," which it is claimed offers both technical and economical advantages over the A brand, are manufactured by the I. G.

With the advent of so many materials, all offered for the same purpose, many of them varying in chemical composition, and the technical value of which is not determinable by analysis in the ordinary sense of the word, it became quite a task for the average laboratory to decide on the relative merits of the many competing articles.

In one of the German circulars the following note appears:

"It is very difficult to determine the value of a wetting-out agent definitely, whatever tests are employed, as these hardly ever comply with the conditions obtaining in practical working. For a trial which gives some rough idea it will suffice if cuttings of equal size, but of different qualities of cloth, are placed upon the surface of the solution of the wetting-out agent to be tested, and the time which they require for saturation should be recorded by a suitable watch. In practical working the effective value of a wetting-out agent is best ascertained by continuous trials carried on in the regular process of manufacture."

While it is probably quite true that the effective value of a wetting-out agent is best ascertained by continuous trials carried on in the regular process of manufacture, it is not always feasible or possible to do this, and there is undoubtedly a demand for a test which may be conveniently carried out in the ordinary laboratory without the use of any special apparatus and which will determine the comparative value of one agent against another, or which will enable a chemist to check up deliveries against standard.

Auerbach's Test, and Others

The method which was briefly outlined in the quotation above is based on the article written by J. Auerbach and appearing in Melliand's Textilberichte for 1926. It might be well to give the exact procedure adopted by Auerbach for purposes of comparison with the method which I am later to suggest:

"For these experiments they used raw wool especially prepared in the fulling machine to secure a uniform condition of the surface. The pieces of the material used were squares measuring 4 cm. on a side or 16 square cms. total. To be positive that the surface of the material used for the tests was absolutely uniform special treatments were devised. Before using, the woolen pieces were treated so as to be certain that they all contained a uniform amount of air and moisture. The relative time necessary to completely immerse was calculated with stop watches in seconds. Special precautions were taken to be certain that each piece of material was placed absolutely flat on the surface of the solutions and that no air-bubbles were between the surface of the liquid and the material. The tests were conducted on 1 liter solutions of equal surface area, and each test was repeated five or more times and the tabulations represent the average.

"Cotton in various forms was also tried but the results obtained were not as consistent as those with the specially prepared wool."

Auerbach's method was proposed only after methods previously suggested had been found satisfactory. Auerbach has described some of the earlier methods and epitomized the objections against them as follows:

M. Frieberger has proposed to permit a given number of drops of a solution of the wetting agent in water to fall from a burette on to dry cloth and calculate the time necessary for the drops to have been absorbed by the material. He suggests the drops be permitted to fall 4 cm. before reaching the cloth, and remarks that at least ten such tests are necessary to obtain reliable comparisons.

Herbig remarks that while this method is simple its reliability is questionable and suggests the following: Equal weights of raw Mako yarn carefully weighed and containing equal amounts of air and moisture, and stretched by suitable means to a 50 gram tension, are immersed for 1 second in solutions of the wetting agents, immediately hydro-extracted and weighed and the value calculated on the amount of the gain in weight. He suggests the necessity of from 6 to 10 tests for each sample.

K. Voltz remarks that this method is limited to such laboratories as contain the necessary apparatus, and he has recently published the results of his investigations of experiments made as follows: Equal length raw cotton skeins are suspended by suitable means so that one-third may be immersed in solutions containing the wetting agents, in strengths of approximately 1:500. (2 grams per liter.) The solutions also to contain a small amount of Methylene Blue. This is done to determine the wetting through capillary attraction which is evidenced by the solutions creeping up through the skeins. At the same time the more or less complete immersion of the immersed portion of the skein and the time necessary indicates the relative wetting action.

F. Junger suggests the following method: The spraying or spreading of powdered sulphur, Indigo powder, loose raw cotton or kapok fiber on the surface of solutions containing the wetting agents and calculating their relative value in accordance with the time necessary for a complete immersion.

Erben recommends determination of the wetting ability of solutions containing the same known amount of fatty acids by placing on the surface of the solutions equal size samples of either raw loose cotton, raw cotton or woven cotton materials.

G. Bernhardy has also suggested a similar method.

A More Reliable Method of Testing

The Auerbach method, however, still leaves room for improvement, and L. G. Lawrie, of the B. D. C., has proposed a method for the comparative determination of the wetting-out value of these materials which appears to be more reliable and accurate.

The apparatus is simple and such as is found in any laboratory, the method easily and quickly performed, and the results obtained over a comparatively long period have been remarkably uniform.

It must be understood that the method in no way determines the chemical composition, the percentage or strengh of the materials involved. It simply gives a measure of the penetrative and wetting-out ability of the material under examination.

Briefly, the method proposed by Lawrie depends on the observation of the length of time taken by a definite volume of the wetting-out solution to wet out and flow through a piece of cloth of exact size under certain definite and easily controlled conditions.

The apparatus consists of a burette of a capacity of 25 c.c. which is filled with a solution of the substance under examination and which discharges into a short length of wide glass tube, the diameter of which should be in the neighborhood of 40 m.m. The upper end of the tube is open and placed directly under the burette, while the opposite end is covered with a piece of standard cloth, held in position by means of a strong rubber band.

In the experiments performed in the laboratories of the B. D. C., the cloth used was a Botany worsted serge of the average type used for men's wear, and work in our own laboratory here seems to confirm that such a type of cloth is best suited for the purpose of the test.

Experiments have also been conducted with cotton cloths of various types, but the results are not so accurate, so far as we can determine at present; a cotton broadcloth has given the best results so far, and perhaps may prove entirely satisfactory with a variation in the diameter of the tube.

The piece of tube is so placed beneath the burette that the distance from the cloth to the tip of the burette is 100 m.m. The diameter of the tube with a given quantity of liquid plays an important part in the test because this determines the head of liquid which, exerting a pressure on the cloth, accelerates the wetting-out of the material.

With tubes of smaller diameter and the consequent larger head of liquid the penetration and the wetting-out of the material takes place more rapidly, and there is no doubt that the test can be modified so as to obtain a satisfactory working time by varying the diameter of the tube according to the type of cloth used as standard.

The apparatus is completed by placing below the cloth a small measuring cylinder marked at 20 c.c. and fitted with a funnel. The method of working is simple. The burette is filled with 25 c.c. of a solution of the wetting-out agent, and this amount is run rapidly as possible into the tube. It is essential that the burette have a comparatively large orifice so that its contents are quickly discharged.

Plotting the Results

With a suitable stop watch the time is taken from the moment of opening the burette tap until 20 c.c. of the solution have run through the cloth and funnel and collected in the measuring cylinder. The tests, of course, are all made strictly comparatively and with solutions of various strengths, of from 1 to 10 gr. per liter. The results may be shown in table form or in the form of a graph, if necessary, by plotting time against the strength of solution.

Tests can also be made at various temperatures, and an absolute measure of the wetting-out efficiency of various materials comparatively one against the other can thus be obtained.

Auerbach has suggested that tests be made with solutions of 5—3—2—1 grams per liter, and at temperatures of 16, 30, 50 and 80 deg. Cent., and this seems to admirably cover the ground. Practically all of the materials examined wet out and flow more quickly at elevated temperatures and at the higher concentrations. The most valuable material, of course, is that which wets out in the shortest time at the lowest concentration.

It is not my intention to take up any time by reading whole tables of results given by this method. The results are, after all, only comparative and the actual figures obtained are not important to record and mean nothing of themselves.

It is sufficient to say that results are obtained comparable to within 1 second and to an average deviation of 3 to 5 per cent.

It has been ascertained by experiment that the humidity of the cloth and its tension over the tube make very little difference to the result.

Besides the use for evaluating actual wetting-out

materials, it would seem that this method offers an easy manner of testing the efficiency of actual wetting-out liquors. Solutions made up in accordance with a practical formula could readily be tested one against another and the wetting-out value determined. It seems as though it might afford a quick and ready means of determining the best constituents for scouring and wetting-out liquids that had to be designed to accomplish certain objects. In addition the apparatus is also applicable for the testing of those particular compounds which have been suggested for use as aids to penetration in the carbonizing of wool and the mercerizing of cotton. Of course, instead of water being used to make the solutions of the various penetrating mediums, sulphuric acid and caustic soda, respectively, would be employed.

I hold no brief for this method, but would be interested if those of you who have the opportunity of comparing laboratory data with actual practical trials would interest yourselves sufficiently to determine whether it has actual value to the textile chemist.

Applicant for Membership

Active Members

Whelchel, Homer, chemist, Central Franklin Process Company, Chattanooga, Tenn. Sponsors: T. Glendinning and H. Schroeder.

Seventh Annual Meeting

of the American Association of Textile Chemists and Colorists

will be held in

New York

at the

Hotel Pennsylvania

December 2nd and 3rd

Technical Session,
Saturday Morning and Afternoon.
Annual Banquet Saturday Evening.

Informal Smoker and
Open Forum
Friday evening.

The programs of the Open Forum, the Technical Sessions and the Annual Dinner are outlined on the next page.

Check the dates now!

PROGRAM
Seventh Annual Meeting

Open Forum Session—Friday Evening, December 2

Discussions

What Constitutes an Education for a Textile Chemist and Colorist?—Prof. L. A. Olney and Dr. R. E. Rose.

Vat Color Dyeing—Charles Williams

Co-operation of Mill and University in Research.

Rayon Processing—Robert P. Morningstar.

What Are the Present Difficulties Encountered in Processing Rayon?

—And other topics.

Technical Sessions—Saturday, A. M. and P. M., December 3

Papers

Work Done to Increase the Resistance of Rayon to Water—John E. Jackson.

Dip Dyeing Hosiery—Louis Zisman.

Detergents for Wool: Relation of pH to Detergent Efficiency—Prof. Chas. E. Mullin.

Washroom Practice in the Power Laundry and Its Relation to Dyed Fabrics—George H. Johnson.

Ever-Changing Textile Problems of the Dry Cleaner—Lloyd E. Jackson.

Methods of Handling Cotton and Rayon Piece Goods in Dyeing—John S. Warner.

Kierpon—New Process for Bleaching Colored Striped Cotton Materials—A. P. Thompson, Jr.

Color Evaluation by Spectrophotometric Methods—Dr. Carl Draves.

Mechanical Dispersion and the Colloidal Mill —P. F. Travis.

Reports of Committee on Light Fastness and Other Committees.

Annual Dinner—Saturday Evening, December 3

Speakers:

Hon. James J. Walker, Mayor of the City of New York.

Frank Alvah Parsons, president, N. Y. School of Fine and Applied Arts, New York and Paris.

Walker D. Hines, president, Cotton-Textile Institute.

Dr. Louis A. Olney, president of the Association.

Dr. D. W. Daniel, Clemson College, S. C.

Toastmaster: P. J. Wood, vice-president, Oriental Silk Printing Company

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Important data concerning railroad fares, hotel reservations, etc., will be shortly sent to members, with a reservation card which they will kindly fill out and return *promptly*.

Members may invite as many personal guests as they desire—but should remember to make dinner reservations for everyone.

Out-of-town members will be the guests of the New York Section for luncheon on Saturday.

COMMITTEE IN CHARGE

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AMERICAN
DYESTUFF REPORTER

Devoted to the use and application of dyestuffs and the mechanical equipment incidental thereto.

LOUIS A. OLNEY
PROFESSOR OF CHEMISTRY AND DYEING, LOWELL TEXTILE SCHOOL
Directing Editor

CLAYTON HOAGLAND
Managing Editor

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A PROBLEM OF DEFENSE

THE recent merging of European chemical trusts has inspired many an eloquent comment in this country. The present situation is too well known, therefore, to require further elucidation. But there still exists a deal of confusion in the trade as to the best course to be followed by the American industry in opposing this powerful alliance that has been reared across the Atlantic. Nothing we have heard has served more effectually to clear up some of this confusion than Dr. Charles H. Herty's address before the recent meeting of the Salesmen's Association of the Chemical Industry. Though the REPORTER is not in accord with the speaker on one or two points, it must concede that his survey of the problem was made at an opportune time.

In opening his address Dr. Herty spoke of the purposes of the new European cartel, which comprises the united chemical trusts of Germany, Great Britain and France, and possibly other countries. What is termed "rationalization" is indubitably its primary aim: mass production and economic marketing, the allocation of markets, the fixing of prices. It is not, Dr. Herty stated, an attack on our chemical export trade, for that trade looks lamentably small when compared to the total export business of those in the cartel. But back of the alliance is a desire to crush the American foreign trade through a fear of what it *may* become.

Furthermore, the speaker observed, European industry cherishes the hope that a reduction of our tariff will shortly open the gates to an invasion of American markets; and what instrument could be more effective in forcing this invasion than the new cartel? Dr. Herty characterized the cartel as a "hybrid alliance" that in the light of history will not function harmoniously.

But he emphatically condemned the proposal to repeal our anti-trust laws to permit the formation of an American chemical trust.

He averred that this country long ago turned from the monopolistic system and insisted that the consumers' interests must be kept always in sight; for, he asserted, cartels lead to the very unpopular nationalization of industry. President Coolidge has intimated, he said, that he does not favor repeal of the trust laws. Dr. Herty pointed out that American manufacturers may, if they would, combine for an export fight under the Webb-Pomerene Act, and that nothing prevents smaller firms from merging to form a stronger unit. But he does not believe the repeal of anti-trust legislation would usher in an American chemical trust. He would preserve the Sherman Law inviolate. He further declared that under tariff protection the American dye industry has been able to increase the efficiency of its operations and reduce prices, to the evident benefit of consumers, and he urged strict maintenance of the present tariff.

As to the industry's course of action, he advised that it co-operate more closely with governmental bodies, such as the Federal Trade Commission; that the restrictions on Paragraphs 27 and 28 of the tariff, covering dyes and intermediates, be removed to bring them within the flexible provisions of the tariff in order that the President can, if necessary, increase the rates on these products; and that our trade associations should be strengthened by more active participation in their work by members of the industry. Finally he stressed the paramount importance of research. "This fight," he declared, "is not one which is going to be for a day, a month or a year."

Although this address admirably clarified the situation, it should be observed that Dr. Herty advanced several debatable arguments—points on which he is, we believe, opposed by many in the chemical industry.

Expressed briefly, the situation represents, to borrow an apt phrase from Dr. Herty, "a clash between two antithetical economic systems." In this country we have a highly competitive dyestuff industry, an industry in which the rewards are meager, in which there is inefficient duplication of production, of sales effort, of research; all of which raises trade costs much higher than under a cartelized system. To the east we face a formidable European phalanx of unlimited resources that in any emergency will be supported by the governments of the powers. Duplication in everything will be virtually eliminated.

Is it not obvious, therefore, that the immediate concern of the American dye and chemical industry is to reduce its costs, that it may reduce its prices to meet those of Europe's alliance and still make a fair profit? How can costs be cut to the minimum when severe competition is the business order? Granted that small firms may, if they choose, combine, forming a stronger unit, will they not still be competing sharply with three or four even stronger American chemical units? And will not duplication still prevail, to keep costs, and consequently prices, higher than those of Europe? If this also be granted—and it seems obvious enough—then we have not yet solved the old problem of retaining and developing our foreign trade

and defending home markets in the event of a tariff reduction.

Too much dependence is placed on the tariff by those who would uphold the competitive system as the most profitable for the American dye industry. As the most logical and effective barrier to foreign aggression, the tariff certainly should be supported. That is readily granted. But do we know how long the present rates will be maintained? We do not. Too many factors—among them the European debt situation and strong anti-tariff sentiment in Washington—are involved not to constitute an opposition that may eventually force a downward revision of the tariff. For such a contingency the American dye industry must be fully prepared.

Too much is ascribed to the tariff's protecting influence. While it may be conceded that under the tariff the American dyestuff industry has been able to develop to a degree unprecedented in our industrial history, we cannot ascribe to the tariff alone the steady decrease in domestic dye prices. Our dye manufacturers know that prices have been depressed to their present uneconomic level principally by the severe competition.

That competition can be lessened, but by nothing short of practical co-operation among members of the industry. Co-operative marketing, co-operative research liberally financed, elimination of duplicate effort wherever possible—these must be the order of business if costs and prices are to be reduced. And prices must be reduced without destroying the margin of profit on which every industry depends. If this can be done without running afoul of the anti-trust laws, well and good; then let the Sherman Act stand. But some definite action of this character must soon be taken if we are to meet the phalanx in Europe on equal terms in the impending trade war.

THE TOBOGGAN OF DYE PRICES

THE man in the mill who orders the dyestuffs generally purchases other chemical supplies higher or lower in price than dyes. He cannot avoid comparing mentally the prices of colors with the prices of these other materials, and in this way many colors often appear too costly when compared with something similar. If a certain color jumps four or five cents per pound while other chemicals are unaffected, the conclusion is that dyestuff prices are rising.

Much depends on the viewpoint, however. If the mill man could view dye prices through the eyes of the dyestuff manufacturer he would realize that colors have taken a tremendous slump in price during the past few years. A chart of dye prices would show him a line that dropped away in a sharp slant from 1917 to 1927 without the slightest reaction. Every well-informed dye manufacturer has watched the steady, disheartening toboggan taken by dye prices over the past ten years. The weighted average price a decade ago was $1.26. For last year—1926—it was computed as 42 cents. And that is a full ten per cent less than the average for 1925.

Take individual colors—striking examples rather than typical ones—to bring out this point. Indigo, first produced in 1917, sold then up to $1.42 per pound. To-day—you know it is down to 13 cents. The latest Census of Dyes lists the average prices of nearly one hundred dyestuffs for the years 1922 to 1926 inclusive—not selected at random but dyes that form *ninety* per cent of domestic production. Consider these few comparisons:

	1922	1926
Chrysoidine Y	$0.63	$0.34
Developed Black BHN	.91	.50
Direct Blue 3B	.78	.39
Direct Yellow R	.81	.49

Extreme examples? Yes; but they are given here to emphasize the real trend, for everything else on the Census list dropped steadily in price throughout the entire four years, with but two or three exceptions.

As the Census points out, the 1926 average price for dyestuffs was about *one-half* the 1921 price and *one-third* the 1917 price. With what important result? The average *annual* decrease for the past four years in the revenue of our dye manufacturers from their sales has been six million dollars. And their costs of production have certainly not decreased to nearly the same extent.

Many mill men and not a few manufacturers of colors could learn many significant facts of this nature about the dyestuff industry from the annual Census of Dyes. The Government Printing Office in Washington supplies copies of the new 1926 edition at 30 cents each.

THE TEXTILE ALLIANCE FUNDS

Good news is often submerged by the mass of trivial items that clutter up the pages of the daily and trade press. This seems to have been the case with the announcement made last week by the Textile Alliance, Inc., that the assessment of tax against it by the Government has finally been adjudicated by the Board of Tax Appeals in favor of the Alliance.

To readers familiar with the history of this important case this news should be very gratifying. The Textile Alliance was incorporated under the provisions of the Membership Corporation Law of the State of New York, mainly for the purpose of protecting mill owners and operators and reforming trade abuses, in the manufacture and sale of mill supplies and the persecution of crimes in connection therewith. It had no stockholders and under the laws of New York it was a non-profit-making organization and no part of its net earnings could inure to the benefit of any private individual. It was essentially a trade organization, and after the outbreak of the war its operations were conducted on behalf of and as a conduit for the members of its associated organizations in connection with the importation of wool, dyes and other essential products. After the United States entered the war the Alliance acted as a quasi-governmental agency.

In the course of its dyestuff operations, acting for the Department of State, a fund of nearly two millions was accumulated, the greater portion of which, under the

agreement with the State Department, was to be devoted to scientific research and education. The Treasury Department, however, saw fit to lay claim, under the Income Tax and Excess Profits Tax Law, to approximately one and one-quarter millions of dollars of the fund. The Government, in short, regarded the Alliance as a privately owned stock corporation organized and conducted for profit.

By the decision just announced this tax claim has been annulled, leaving the funds free for distribution as soon as certain unimportant questions still pending with the Government can be settled.

While nothing definite can be learned regarding the ultimate manner of using the large fund in question, it is assumed that the original purpose of devoting it to scientific research and educational purposes can now be carried out. Inasmuch as the activities of the Textile Alliance were so intimately identified with the interests of the textile and dyestuff industries, would it not seem most appropriate to allocate a liberal portion of its funds to the financing of some of the worthy research projects now being undertaken in textile chemistry and dyeing?

NEW SERIES OF VATS PRODUCED BY DU PONT

A series of vat dyestuffs developed especially for printing is announced by the Dyestuffs Department of E. I. du Pont de Nemours & Co. These new colors will be marketed under the trade name of Leucosol Colors and, according to the announcement, will be characterized by exceptionally good fastness and working properties.

The Leucosols are described further as non-foaming and grit-free and extremely homogeneous, so that they do not settle out. As they are claimed to be non-drying, it is pointed out that they do not form crusts in the barrels and thus the printing pastes remain uniform in strength.

In most cases the paste of the Leucosols can be prepared with no glycerine or with less than the quantity usually employed with vats, the amount depending on conditions of aging.

JAPAN SUBSIDIZES INDIGO MANUFACTURE

It has now been definitely given out that the Japanese Government Department of Commerce and Industry will pay 200,000 yen yearly in subsidy to local manufacturers of artificial Indigo, beginning with 1928. It is questionable, however, thinks a local journal, whether this will go far toward inducing the home industry to turn out the dye in quantity.

Efforts are now being made by the Kiike Dye Industry Station and the Nippon Dyestuff Company to produce artificial Indigo. They have confidence, it is said, in their success, but improvement is necessary in equipment before it can be produced commercially in order to meet the yearly consumption of 1,500,000 pounds.

"The improvement in equipment would cost," says this journal, "more than they feel justified to meet from the 200,000-yen grant to be offered by the Government, and the prospect of Japanese industry being able to meet the demand in full is remote."

DYERS URGE LOWER WEIGHTING

As the result of a meeting of dyers who are interested in weighting problems, held recently at the headquarters of the Silk Association of America, Inc., New York and Paterson piece dyers who do weighting have sent letters to their customers recommending that in the process of tin-weighting piece-dyed merchandise no goods other than raw chiffon should be given more than three passes of tin, or 30 to 40 per cent weighting.

Proper weighting of fabrics enhances the appearance of silk and gives it a rich draping effect which the feminine consumer of to-day demands in order that her gown may hang gracefully, but it was considered by dyers who attended the meetings that, taking into consideration their own observation and tests which they had conducted to establish a standard figure for all demands, the most satisfactory results are secured on flat crepes, crepe-de-Chine and Georgette at a weighting of 30 to 40 per cent, and adopted a resolution to that effect.

Dyers in both Paterson and New York have been making an effort for some time to stabilize the present condition of a market which is said to show an unprecedented demand for heavier weighted goods similar to that of several years ago in yarn-dyed silks, and the resolution recommending moderation in weighting was adopted after several meetings of dyers had been held at the headquarters of the Silk Association of America, Inc., to discuss the problem.

Dr. Thomas Nelson, dean of the Textile School of North Carolina State College, attended the two-day session of the Southern Textile Association at Birmingham, October 28 and 29.

The association is composed of superintendents and overseers of cotton mills in the South. Dr. Nelson is a charter member of the association and was a member of the first board of governors. He has taken a prominent part in the development of the Southern textile industry.

JAPAN'S CHEMICAL INDUSTRY

Because of the interest at present in the development of a strong chemical industry in Japan, particular attention is being given to an official report, just issued, of the Japanese Chemical Industry Society giving in detail a report on the output of various items of the Japanese industry during 1925. While a figure for last year is not yet available, it is not thought that production last year, or this, will differ to any large extent from that of 1925. The number of chemical factories in Japan at the end of 1925 was 2,498, according to a governmental report, and the number of persons employed in those factories was

123,063. Amounts of fuel used during the year were: Coal, 2.13 million tons; coke, 49 thousand tons; petroleum, 55 thousand cbms.; gases, 594,196,657 cft.; and wood charcoal, 20 thousand tons. Electric power consumed was 1,029,276,906 kilowatts. Production totals of a few important products were as follows:

	Pounds
Sulphuric acid	1,156,151,029
Hydrochloric acid	51,549,808
Soda ash	24,607,824
Caustic soda	56,047,164
Aluminium sulphate	32,753,449
Bleaching powder	81,326,480
Acetic acid	8,759,447
Methyl alcohol	1,152,103
	Kwan
Ammonium sulphate and superphosphate	188,967,806
Cyanamide	13,243,072

OAKITE CONFERENCE ON CLEANING

Service men of Oakite Products, Inc., held their annual conference last week to discuss cleaning and related problems. The meeting also marked the completion of nineteen years of Oakite cleaning service. Field representatives from thirty-three States and Canada gathered to discuss mutual problems and exchange experiences in connection with their working of advising scores of industrial establishments on methods of cleaning—cleaning problems and experiences ranging all the way from phonograph needles to locomotives.

A technical program of sixteen technical papers supplied the main feature of the conference this year. Among the papers presented, one treated of "Oakite in the Dyehouse."

GENERAL DYESTUFF ISSUES NEW SHADE CARDS

Nine new shade cards have been distributed to the trade by the General Dyestuff Corporation of New York covering new products of the I. G. Farbenindustrie Aktiengesellschaft. The subjects of these cards are: Mordant Dyestuffs on Printed Cotton; Standard Shades on the 1927 Fall Color Card of the American Textile Color Card Association; Katanol W on Union Pieces; and Acid, Mordant and Basic Dyestuffs on Weighted and Unweighted Silks.

The card on Mordant Dyestuffs on Cotton displays 122 swatches, each in three shades, with complete printing recipes and percentages for each pattern.

The card showing the Fall Standard Shades contains brief text giving dyeing directions and percentages for obtaining each shade. Eighty different swatches in a variety of hues are exhibited.

The Katanol W card illustrates the use of this product in union dyeing, displaying fifty different patterns swatches, each dyed in two shades, with a text giving their methods of application and recipe percentages.

The six cards showing various classes of dyestuffs on unweighted and weighted silks contain a number of very attractive print patterns in various combinations of tints, with formulas for each patern. As mentioned above, these cards cover basic, mordant and acid colors.

A CARD ON INDIGOSOL PADS

An attractive shade card just issued by Carbic Color & Chemical Company of New York displays Indigosol Pads on mixed fabrics of viscose silk and cotton. The Indigosol series are manufactured by Durand & Hugenin, S. A. of Basle, for whom the Carbic Company act as American representatives. The text of the new card explains that the use of the Indigosols on mixed fabrics of the type shown offers the advantage of obtaining level dyeings without impairing the quality or luster of the rayon.

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i. e., help wanted, machinery or supplies for sale—the rate is $5.00 per column inch or less per insertion.

SALES EXECUTIVE WANTED

Manufacturer of aniline dyes desires for the New Jersey and Pennsylvania territory one familiar with this territory to conduct and direct sales policy, etc. Communications treated strictly confidentially. Address Box 425, American Dyestuff Reporter.

CHEMIST-COLORIST

Chemist-colorist, ten years' experience in application and standardization of dyestuffs. Thorough practical experience in dyeing and weighting of silk piece goods. Seeks position with opportunity. Address Classified Box 426, American Dyestuff Reporter.

SALESMAN WANTED

Experienced dyestuff salesman for Southern territory; one having working knowledge of soluble oils, softeners, etc. Will consider only those who have acquaintance with Southern mills. Address Classified Box 427, American Dyestuff Reporter.

DYER'S ASSISTANT

Textile chemist with years of laboratory experience, especially in the dyeing of silk hosiery, desires position in dyehouse. Textile school graduate. Address Classified Box 428, American Dyestuff Reporter.